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Ⓒ

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Abstract

A technological analysis of nineteenth century Copper Inuit antler artifacts is presented. The artifacts are from several sites on Banks Island, N.W.T. The island was occupied by Inuit involved in salvaging large quantities of raw materials (metal and wood, for example) from a cache abandoned there in 1854 by a British exploration vessel.

A process model of antler tool production is developed which incorporates six stages of manufacture. It delineates the steps whereby whole antlers are reduced to finished artifacts. Five techniques are identified as important in modification of antler: grooving; whittling and/or scraping; chopping; sawing and/or cutting; and drilling. Both ethnographic and experimental analogues were used to link these processes with resulting morphological patterns on antler. Several of these patterns, or technological attributes, are identified on archaeologial specimens.

Analytical results are used to make intrepretations about antler use and artifact production. First, variation in frequency of occurrence of stages of manufacture was demonstrated. The class of debitage is present in highest frequency at all three sites. Two categories of debitage are defined. It is suggested that this division has analytical utility. Preliminary modification debitage is indicative of initial processes of antler reduction. Other by-product material may be produced during secondary and finishing stages of manufacture. Second, finished artifacts were also

present in high numbers. This feature may be related to occupation history of two sites, as inferred from subsistence data analyzed by others.

Technological attribute frequencies varied in occurrence by stage of manufacture. This result indicates that certain techniques were used for preliminary reduction, while others represent finishing modifications.

Some trends in technological change are identified, based on comparisons between the archaeological assemblage. and collections described in the literature that pre-date and post-date the nineteenth century. Iron and steel tools, and especially saws, were used to modify antler in the archaeological sites sample. Technological features such as the groove and splinter technique, drilling holes to section pieces, and surface grinding were infrequently observed on Banks Island specimens. Other techniques, including cutting and sawing, are present in higher frequency. The difference is related to use of metal knives and saws. The probable source for these non-native tools was the Mercy Bay cache.

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I. INTRODUCTION

Historical Background

The problem addressed here is one aspect of a major research endeavor initiated and conducted by Dr. Clifford Hickey, the University of Alberta. The Copper Inuit Research Project is a long-range, holistic study of Copper Inuit culture, focusing on processes of culture change in the pre-ethnographic period. Hickey (1982) hypothesizes that as a result of indirect, yet decisive contacts between Copper Inuit and British exploratory expeditions during the mid-nineteenth century, significant alterations may have occurred in traditional Copper Inuit culture. The period pre-dates the ethnographic present, the phase of earliest ethnographic description (Trigger 1981).

The hypothesized changes took place when Copper Inuit from Victoria Island discovered and began salvage of substantial quantities of British goods cached at Mercy Bay, northern Banks Island. The cache had been deposited there in 1853, by the crew of the H.M.S. *Investigator*. The *Investigator* had been dispatched in 1850, along with the *Enterprise* to continue the search for Sir John Franklin's missing expedition (McClure 1969).

The *Investigator* searched in Prince of Wales Strait and spent one winter there. During that season, contact was made with Inuit camped on the sea ice off Berkeley Point, Victoria Island. These Inuit were interviewed by Miertching, interpreter for the British expedition, and one hunter drew a map of the western and southwestern Victoria Island coast. Captain Robert McClure provided a brief description of the copper implements of the Inuit.

> Copper of the purest description seemed to be plentiful with them, for all their implements were of that metal; their arrows were tipped with it, and some of the sailors saw a quantity of it in a rough state in one of the tents (McClure 1969:188).

This encounter proved to be the only one between the *Investigator*'s crew and local Inuit.

That August (1851), McClure circumnavigated Banks Island along the west coast, eventually berthing for the winter in Mercy Bay. There, the *Investigator* was frozen in, and remained so for two winters before the stranded crew was rescued by still another search party. The ship was abandoned and a cache deposited on shore. Some of the items in the cache were probably considered valuable raw material to the Inuit who eventually found and salvaged them. The cache included: six boats and complete gear; one chest of tools; one grindstone; two boat coppers; one crosscut saw; 100 empty casks (the metal bands of which have been found in Copper Inuit sites modified into tools); a tent; seven tons of coal; food stuffs; footgear and clothing (Hickey 1981:3).

How the Copper Inuit from Victoria Island found the store, in an area which was apparently not part of their normally exploited hunting territory is unclear (no Copper Inuit sites which definitely pre-date the salvage period have been discovered on northeastern Banks Island (Hickey 1981)). One may speculate that the brief encounters with the

British, in which a few metal trade items were presented to the Inuit, made them cognizant of the valuable resource the European goods represented. Quest for items like metal may have led them to follow the presumed route of the *Investigator*, since McClure had questioned them in 1852 as to whether Banks Island was, in fact, a circumnavigable island (Manning 1956:34-35).

Documentation of the salvage period is provided by Stefansson (1921:240-241) from informants' accounts:

> The same Eskimo (the Prince Albert Sound group) told me that at a time which I estimate as less than half a dozen years after McClure abandoned his ship the Investigator in the Bay of Mercy, some Eskimos had found her. She was to them, naturally, a veritable treasure house, especially her iron. The news spread through Eskimo communities as far south as Coronation Gulf and east towards King William Island, and the Bay of Mercy for twenty or thirty years became a place of pilgrimage for perhaps a thousand Eskimos. They made long trips there to get material for knives, arrow points and the like, certain families making the journey one year and other families another year.

However, in Stefansson (1913:280ff) he makes it clear that it was only the Minto Inlet and Prince Albert Sound people who actually moved onto and "resided" on Banks Island during the salvage period (see Chapter Two, page 19 for more discussion of Stefansson's account).

It is also documented archaeologically that the Mercy Bay cache goods were salvaged and utilized. Several researchers have noted the presence of non-native, and therefore presumably *Investigator*, material in Copper Inuit material culture collections (Albrecht and Berke 1977:148; Hahn 1977; Hickey 1979a, 1981, 1982; Jenness 1946; McGhee

1972:99; Manning 1956:34). Jenness (1946:97), for example, illustrates a snowknife with a metal blade said to be made of hoop iron from the Mercy Bay cache. Hahn (1977), described antler tools from two Copper Inuit sites on Banks Island and reported that antler artifacts examined by him had been made, in part, by metal tools. This statement was based on observations of incisions on antler debitage and artifacts. Metal tools were also recovered from the archaeological sites; they included axes or hachets (*les haches*) and iron saws (*scies en fer*). Hahn (1977:341) suggests that these materials were obtained by salvage from the ship.

As a consequence of the sudden influx of large amounts of exotic and valued goods, alterations are hypothesized by Hickey (1982:4) to have occurred in several facets of Copper Inuit culture. These changes were in subsistence, settlement patterns, trade and commerce, social organization, and material culture. They came about both as results of the economic reorganization necessary to exploit the cache, and to reconcile the social problems initiated by the unequal access to the cache, occuring as it did, at one extreme corner of Copper Inuit territory (C. Hickey: personal communication).

The material culture changes include increased use of metal tools, changes in some native tools to adapt to metal parts, and introduction of some new tools (eg. metal saws, axes and files). However, other features of material culture remained the same. The production of items from caribou antler is one such feature. Use of a wide variety of antler tools was described ethnographically for the Copper Inuit. Evidence for antler tool production and use is also found at the nineteenth century Copper Inuit sites on Banks Island, and demonstrates continuity in tool form, and therefore, possible function from the nineteenth to the twentieth centuries.

Problem Statement and Methodology

The focus of this study is an examination of the antler technology from three nineteenth century archaeological sites on Banks Island. The goal is to reconstruct the technology by an analysis of the antler artifacts. A process model of antler tool production is developed, and used to classify the modification techniques employed in the creation of finished artifacts. The model, presented fully in Chapter 4, describes the techniques by which whole caribou antlers were subsequently reduced to the stage of finished artifacts. It therefore essentially classifies materials into sequential stages of processing, as inferred from the modification attributes observable on them.

Several unique features of the Banks Island Copper Inuit archaeological record provide a good opportunity to study bone technology. First, excellent conditions of preservation permit the recovery of bone material representing several processing stages. For example, at each of three large sites where the author worked, collected material included whole antlers with minimal modification, small shavings and splinters of discarded material, and artifacts recognizable in form as finished tools.

Second, the sites all date to the pre-ethnographic period of the late nineteenth century and are, therefore quite recent in age. This temporal affiliation is determined from historical documentation (Stefansson 1921, cited above) and site contents. The three main study sites all contained non-native items (wood, metal and in one case, textiles) which in all likelihood were derived from the Mercy Bay cache. Minimal biological or geological disturbance has occurred at the sites, in part because of their recent age. The sites are not buried; stone features, artifacts and bone scatters are observable on the surface. The author was able to observe, for example, small concentrations of antler shavings and beam and tine sections which may represent activity areas where processing took place.

Third, the recent age of the archaeological materials and their known cultural affiliation provides for reasonable comparison between ethnographic Copper Inuit material culture and the archaeological record. Jenness' (1946) study, **The Material Culture of the Copper Eskimos** was based on his fieldwork from 1914-1916 with the Canadian Arctic Expedition; it represents one of the earliest studies of the Copper Inuit (see the outline of ethnological research in Chapter Two). In that study, Jenness described the standard items of material culture, raw material from which they were made, and some observations on tool use and manufacturing techniques. Many of the kinds of items he described have been recovered from Copper Inuit sites on Banks Island, providing some indication of continuity in tool form, if not function. Ethnographic documentation is used in this study to provide some ideas about 1) the inventory of material culture items produced from antler, 2) kinds of tools used to work antler and the raw materials from which they were made and, 3) technological processes used in antler modification.

In this manner, ethnographic descriptions are used as a general analogy for the archaeological sample, to define the universe of possible tools, techniques, and behaviors which might be important in antler technology. For example, stone tools for modifying antler are present in neither the ethnographic collections, nor in the Banks Island archaeological collections used in this study. Therefore, stone tools are not considered as tools likely used for modifying antler, and were not used in replicative experiments conducted as part of this study.

Using general ethnographic analogy then, inferences are made about antler technology, and more specific statements about tools and techniques are made. Replicative experiments are designed and implemented to test hypotheses by linking observable morphological patterns on experimentally produced pieces with the process which created them. In this way, the experiments are used as a "bridge" from the general ethnographic descriptions to the archaeological data.

The result of this study will be a detailed description of Copper Inuit antler technology. An attempt will be made to demonstrate how such a study may contribute to overall site interpretation. Tool-making technologies using organic remains (antler, bone and wood, for example) are an often neglected aspect of material culture studies. This situation results, in part, from a real paucity of ethnographic descriptions (relevant literature sources are discussed in Chapters Two and Three). Then too, organic remains are often not found in archaeological sites, due to conditions of poor preservation. As discussed above, the Banks Island situation is an unusual one on both these accounts.

Second, documenting one aspect of material culture and technology during a period of culture contact and possible change may provide clues to other features of that material culture. Ethnographic descriptions of traditional societies at the time of contact have provided the basis for making many statements about the archaeological record. Any information that can be obtained about such societies during the pre-ethnographic period may be useful for gauging the utility of those ethnographic descriptions.

Finally, one outcome of this study may be an initial assessment of change in antler technology as a result of the influx of non-native items from the Mercy Bay cache. With the introduction of larger amounts of metals than previously available for making antler-working tools, and the introduction of other, new tool types, changes may have occurred in the traditional antler technology. In other words, if the introduction of new materials from the Mercy Bay cache influenced technological changes, then archaeological assemblages from the nineteenth century sites should be more similar to twentieth century ethnographic collections than to earlier, archaeological ones. Features that may be different are raw material from which antler modifying tools are made, and manufacturing techniques. Literature on archaeological collections is described in Chapter Two. The principal source used is McGhee's (1972) description of Thule and Copper Inuit sites from Victoria Island and Coronation Gulf.

A Definition of Technology

The term "technology" includes a wide variety of behaviors and material products:

> Technology...is the complex of learned behaviors which gives rise to material culture...The knowledge, attitudes, and customs of technologies are as much a part of the cultural baggage of man as his political or religious behavior (Spier 1973:1).

For the purposes of this study, technology has been used in a narrower sense, one which is a traditional archaeological usage. Technology includes the techniques and processes involved in the creation of a particular category of material culture items - in this case, antler technology.

Outline of Chapters

Chapter Two presents background information on archaeological and ethnographic research in the Western Canadian Arctic. Archaeological research by McGhee (1972) was concerned with documenting the development of Copper Inuit culture and will be reviewed here. Features of material culture, technology and raw materials are also described from accounts in the literature. An ethnographic sketch of the Copper Inuit is based on ethnographic accounts of the early twentieth century and contemporary research. A description of Copper Inuit material culture and technology from the ethnographic period concludes Chapter Two.

The replicative experiments are described in Chapter Three. The hypotheses tested are presented, along with a description of experimental research design, implementation, and results.

Chapter Four contains results of artifact analysis. A model of antler tool production is developed for the archaeological assemblages from several sites on Banks Island. Description of technological processes inferred to have been important in antler technology are presented, with archaeological examples.

Interpretation and conclusions are presented in Chapter Five. Technological comparisons are made at the intra- and inter-site level, with other bone technologies and with archaeological and ethnographic collection from the Copper Inuit area. Some suggestions for productive avenues for future research are made, based on the results of this study.

II. THE COPPER INUIT: ARCHAEOLOGY AND ETHNOGRAPHY

Introduction

The Copper Inuit are the most westerly distributed of the Central Inuit groups (Damas 1972a). Historically they occupied a region which included, at least seasonally, the southwestern portion of Banks Island, Victoria Island and the adjacent mainland coast from Cape Parry to Ogden Bay (Jenness 1922a:endleaf map).

The archaeological record for the Copper Inuit begins with the ancestral Thule culture and continues on to the historic period of European contact (McGhee 1972). The major ethnographic sources on the Copper Inuit are Birket-Smith (1945), Jenness (1922a; 1946), Stefansson (1914; 1919), and, most recently, Damas (1969a, 1969b, 1972a, 1972b). These sources will be used here to present a discussion of the development and nature of Copper Inuit culture. This information will provide both a background for further discussion of Copper Inuit material culture and technology, and as a comparative baseline for making inferences about tools and techniques involved in antler modification.

A. Archaeology

The Thule Culture

The development and spread of the Thule culture is taken to represent the emergence of true Inupik, or Inuipiat (Alaska), speaking peoples in the Arctic (see McGhee 1972; Taylor 1963; Ford 1959, among others). Mathiassen (1927:89) first defined the "Thule culture" from his archaeological excavations at Naujan (the type site) and several other sites in the Central Canadian Arctic. He attached the name to "the old Central Eskimo culture" and described it as a maritime-based culture, exploiting whale, seal and walrus. Mathiassen placed Thule origins in Alaska, based on comparison of material culture traits: harpoon heads, decorative motifs and ceramics.

The florescence of Thule culture has been related to elaboration and spread of a specialized maritime subsistence system during a period of climatic amelioration (ca. A.D. 1000)(McGhee 1969/70; Dekin 1972; Stanford 1976). Hunting of sea mammals, especially bowhead whales, is emphasized as a Classic Thule trait. The development of a wide range of specialized equipment is also an Eskimo characteristic associated with a maritime adaptation.

Documentation for the Thule period in the Western Canadian Arctic is provided from excavations by Taylor (1963, 1967, 1970); McGhee (1972); and Morrison (1981, 1983). In general, Thule culture in this area appears to have closer typological affinities with sites to the west. Taylor (1970:26) suggests that the Vaughn and Jackson site assemblages from Victoria Island look "more Alaskan" in the presence of rectangular wooden houses, an abundance of wood artifacts, pottery, and slate blades in the site assemblages. Morrison (1981:264) also sees Alaskan affinities in the Clachan site material from Coronation

Gulf. In particular, the abundant pottery and harpoon heads resemble Alaskan types. Faunal remains from these sites reflect a subsistence base emphasizing caribou and ringed seal (Taylor 1966, 1970; Morrison 1983).

Thule artifact assemblages described by McGhee (1972) are from the Memorana Site, Victoria Island, and the Bloody Falls site on the Coppermine River. The former site contained antler arrowheads, end blades made from copper and ground slate and an antler adze or axe head. Of the nine men's knife handles recovered, one had a fragmentary iron blade piece intact.

The Bloody Falls site assemblage included slate arrow end blades, chipped basalt and ground slate knife end blades, copper fish spear barbs and hooks similar to historic Copper Inuit types, and a ground slate adze blade. Pottery was present at both sites. According to McGhee (1972:54), "Most of the Thule period artifacts described above are functionally similar to or identical to artifacts used by historic Eskimo...". The major difference is in raw material type - ground slate, chipped basalt, antler adze head and pottery. None of these materials were used by historic Copper Inuit (Jenness 1946).

After A.D. 1200 the uniform Classic Thule adaptation appears to have broken down. McGhee (1969/70:180-1) and others have speculated that cooling climatic conditions produced a trend toward local adaptations to specific environmental conditions and the emergence of the historically recognized "tribes" of Inuit.

Copper Inuit Origins

In the west-central Canadian Arctic the transition from Thule to historic Copper Inuit is poorly documented. A paucity of archaeological material for the transitional period has fueled a long-standing controversy concerning Inuit origins generally and Copper Inuit origins in particular [see Birket-Smith (1930) and Mathiassen (1930), for examples of the debate which Inuit origins fostered.]

An inland "proto-Eskimo" origin was postulated for the Copper Inuit by Jenness (1923:551). He argued that their customs, subsistence patterns, material culture and language related them most closely to the Netsilik Inuit. Both groups, in turn, were postulated as descendents of interior-adapted proto-Eskimos, unrelated to Thule whale-hunters, who were forced out of the Barren Grounds by expanding Indian populations.

Taylor (1970) has suggested that the Copper Inuit developed locally from a Thule culture variant. Citing the faunal evidence for Thule subsistence practices from Lady Franklin Point, he argues that a Thule adaptation stressing caribou and seal hunting was extant in the Coronation Gulf area. This adaptation was similar to that of the historic Copper Inuit described by Jenness (1922a) who were probably Thule descendents.

McGhee (1972) attempted to bridge the archaeological gap between Thule and historic Copper Inuit by defining an Intermediate Interval for sites that fit neither a Thule pattern nor an historic Copper Inuit pattern. "The most characteristic feature of all of these sites is the almost uncanny scarcity of artifacts and food bone refuse..." The Intermediate Interval designation is therefore applied to sites on the basis of structural features - the presence of semisubterranean houses without interior construction (*qarmat* structures) and heavy tent rings with stone platform edges. McGhee (1972:67) assigns a time period of approximately A.D. 1600-1771 (with some overlap with the preceding and succeeding periods) for the Intermediate Interval.

Only a few artifacts were found at the three sites excavated by McGhee (1972:61) and assigned to this period. Among these were hunting and fishing implements (darts, arrowheads and fish spear prongs, all of antler) and ground slate end blades. Cut fragments of a steel rip-saw blade were present at the Tardy Site, western Victoria Island. Their presence may indicate some trade contact. However dating of all of the sites is problematic (McGhee 1972:67). Conclusions about affiliation are also difficult to make.

> ...none of the artifacts found are conclusively diagnostic of historical relationships. In general, the greatest resemblance is to the Thule culture; none of the artifacts would be considered exceptional if found on a Thule period site...whereas several would be out of place in the historic Copper Inuit assemblages now known (McGhee 1972:64).

The one historic Copper Inuit site excavated by McGhee (1972:71-76) is the Kunana site, on the northeastern side of Prince Albert Sound, Victoria Island. A small piece of wire and a tin arrow end blade were among the artifacts of European origin.

> Most of the artifacts found at the Kunana Site are identical to specimens from ethnographic collections, indicating a close relationship between the occupants of the site and the Copper Eskimo groups described ethnographically during the early twentieth century... Most of the other artifacts not reported from ethnographic collections represent manufacturing techniques that had disappeared by the twentieth century; stone end blades, women's knife blades and adze blades, bone fish spear barbs and bone needles all had metal counterparts by the period of ethnographic description. This evidence suggests an occupation of the Kunana Site shortly prior to the twentieth century (McGhee 1972:99).

B. The Historic Period in the Copper Inuit Region

Explorers and Traders, 1771-1914

The Historic Period begins with Samual Hearne's visit to the mouth of the Coppermine River in 1771 (McGhee 1972:70). Hearne was the first European to make contact (albeit brief and disastrous) with Inuit in that region. Hearne, accompanied by a group of Chipewyan guides, traveled down the Coppermine River to Bloody Falls. There, an encamped party of about twenty Inuit men, women and children were discovered and all were killed (Hearne 1958:99). A second party of Inuit managed to escape across the Coppermine River.

Hearne's description suggests that the Inuit encountered were Copper Inuit (McGhee 1972:70). He gave a brief description of their possessions.

> Their arms and fishing-tackle are bows and arrows, spears, lances, darts, etc. which exactly resemble those made use of by the Esquimaux in Hudson's Straits...but, for want of good edge tools, are inferior to them in workmanship. Their arrows are either shod with a triangular piece of black stone, like slate, or a piece of copper, but most commonly the former (Hearne 1958:108).

He described copper-bladed adzes, or "hatchets" and "men's bayonets and women's knives" of copper, with the handle of the men's knife made of "...deers horn a foot long..." (Hearne 1958:109). Only two small pieces of iron were obtained from the plundered tents.

Following Hearne, John Franklin made two expeditions to the northwest coast for exploratory purposes. On Franklin's first journey, down the Coppermine River in 1819-1822, Inuit were again met at Bloody Falls. Franklin was able to make communication with one old man and learned that the Inuit called themselves "Nagge-ook-tor-meoot or Deer-Horn Esquimaux" (Franklin 1969:352). The Inuit came to Bloody Falls in early spring to spear salmon. Franklin (1969:354) noted, "He [the old Inuk] held hatchets, and other iron instruments, in the highest esteem" .

Individuals who were probably Copper Inuit were not encountered again until 1839 when Dease and Simpson met a party at Richardson River. John Rae, as a member of Richardson's 1848 expedition, explored the southern coast of Victoria Island. There he visited a settlement of thirteen families near Cape Hamilton (Jenness 1921a:542).

The next contact with Copper Inuit was made by members of the Franklin search vessels *Enterprise* and *Investigator*. The *Investigator* crew met Inuit only once. That encounter, near Berkeley Point, Victoria Island, was mentioned in Chapter One. The crew of the *Enterprise* had more prolonged contact with local residents at Walker Bay during the winter of 1851-1852 and again at Cambridge Bay in 1852-1853. A population of 200-300 Inuit were wintering near Cambridge Bay in 1852-1853. Collinson (1889:286) provided some description of their material culture.

> But little or no iron was found amongst them, needles, knives and fish-hooks being made of copper; an occasional iron or even brass tip was seen on the arrows, and the few and well-worn beads on their persons showed that this was in all probability the first time they had come in contact with white men.

Little substantial contact was made with Copper Inuit for nearly fifty years. Bockstoce (1975:298-299) reports on contacts between American whale men and Copper Inuit. He presents historical evidence to suggest that whalers met Copper Inuit during the last decade of the nineteenth century, perhaps as early as 1891. Scant information concerning the Inuit is available from these reports, however.

In 1902, David Hanbury (1904) journeyed from Chesterfield Inlet west along the coast and up the Coppermine River. Parties of Copper Inuit were met and traded with. Hanbury illustrates typical items of material culture, including copper snowknives, ice chisels and fish hooks, bone knives, soapstone lamps, bows and arrows

(Hanbury 1904:facing 150, 154). Few details about the Inuit are presented, however.

After 1905, traders were present in the Copper Inuit region. In 1905-6 Captain Klengenberg wintered near Cape Kendall, southwestern Victoria Island (MacInness 1932:223ff). He traded "tin ware, iron frying-pans, empty tin cans, and a few knives" for native items including soapstone pots and implements of copper, bone and musk-ox horn. Klengenberg reported that copper objects were common among the Inuit. Other traders reported to have been in the area are William Mogg and Joseph Bernard. Mogg wintered in Minto Inlet in 1907-8. Bernard spent three years in the region, from 1910-1914 (Jenness 1921a:544).

John Hornby spent several intermittent periods, from 1908 to his death in 1927, in the southern limits of the area visited by Copper Inuit (Stewart 1984:184-185). He acquired an extensive collection of Inuit artifacts which was eventually presented to the Geology Museum at the University of Alberta (Whalley 1962:101). The collection is now housed at the Department of Anthropology, University of Alberta. It contains, for example, fishing and hunting equipment, including bone, hide, wood and copper implements, snowknives, bows, arrows, copper arrowpoints, drills, needles, musk ox horn containers and fur clothing. The collection was examined by the author for examples of material culture items produced from antler, as well as antler-working tools, which were copied for the replicative experiments.

Ethnological Research, 1910-1916

In 1908, Vilhjalmur Stefansson, accompanied by zoologist Rudolph Anderson, organized an expedition to the Coronation Gulf area. The Stefansson-Anderson Arctic Expedition was funded by the American Museum of Natural History. Its goals were to collect ethnological and zoological specimens from the western Canadian Arctic. Stefansson's major interest was to visit Victoria Island, where he hoped to study the 'primitive blond eskimos' Klengenberg had described (Diubaldo 1978:24).[1] It was not until 1910 that Stefansson was able to travel to Victoria Island. There, he visited a village of over two hundred individuals in Prince Albert Sound (Stefansson 1913:280 ff). From these Inuit, Stefansson learned that Banks Island was uninhabited. An informant told him that the Banks Island people had been forced to leave the island due to starvation and that most had died or were killed in blood feuds. This event was estimated to have happened fifteen years prior to Stefansson's visit (see also Chapter One, page 3 for a discussion of Stefansson's description of the Mercy Bay salvage operation by the same Inuit).

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[1] Stefansson spent 1906-1907 in the vicinity of Hershel Island, as acting ethnologist for the Anglo-American (or Mikkelson-Leffingwell) Polar Expedition. It was at that time that he heard Klengenberg's stories of the Victoria Island Inuit (Diubaldo 1978).

The Prince Albert Sound people called themselves *Kanghiryuakmiut*.

> The Sound people are evidently the most prosperous Eskimo we have seen; they are the most "travelled" and the best informed about their own country (Victoria Island) and its surroundings... they have been to the Bay of Mercy on north Banks Island and west beyond Nelson Head on south Banks Island...They use more copper than any other people - doubtless because it is more abundant [in their territory] (Stefansson 1913:293).

The classic ethnography of the Copper Inuit is Jenness' (1922a) **The Life of the Copper Eskimos.** A second volume, **Material Culture of the Copper Eskimos** (Jenness 1946) contains a description of material culture prior to the massive importation of trade items. Jenness conducted fieldwork among the Copper Inuit from 1914-1916 as anthropologist assigned to the Southern Party of the Canadian Arctic Expedition stationed at Bernard Harbor.

Jenness provides documentation of Copper Inuit local groups and their geographical distribution, seasonal round, subsistence practices, social organization, economics, and religious beliefs -a standard ethnographic work. Jenness' work is complimented by that of Stefansson (1914, 1919), Rasmussen (1932), Birket-Smith (1945) and Damas (1969a, 1969b, 1972a, 1972b).

These sources will be utilized here to present a description of the Copper Inuit as documented for the period before substantial, recorded culture change occurred. After about 1915, traders, the R.C.M.P. and missionaries were established in the Coronation Gulf region and major cultural changes occurred (eg. introduction of guns, a cash economy, Christian religion) (Jenness 1921a).

C. A Brief Ethnographic Sketch of the Copper Inuit

Geographical and Territorial Groups

The first use of the term "Copper Inuit", for the Inuit of the Coronation Gulf region, was made by Stefansson (1914:13) who records, "Tentatively we shall in the present discussion give them a title from the chief commercial resource of their country - copper." He goes on to assign this name collectively to 16 groups, who were known to inhabit recognized territories (see Stefansson 1914:14-15 for a listing of the group names and associated territory inhabited). Stefansson gave a total population estimate of 1,100 individuals. Jenness (1922a:42) suggests this number was too high, based on his own estimate of 700 to 800 at the end of 1914.

Jenness (1922a:32) points out that tribal designation is difficult to apply to Copper Inuit groups due to the flexibility and impermanence of group affiliation. Damas (1972a:26) has assigned them to a band level of organization, defined by him as:

> The **band** has the qualities of having a name associated with a territory, fusion and fission over the year's cycle, a large core of the same personnel returning each year, genealogical continuity within, and, usually, aggregation as a whole at some point during the cycle. This designation fits the winter sealing aggregation quite well...but also applies in large measure to the groups named for summer hunting districts.

Seasonal Round and Group Structure

The Copper Inuit followed a "typical" Central Inuit pattern of seasonal movements in response to resource availability (Boas 1974:419; Mathiassen 1928:237). Summers were spent on land and winters were passed in sealing camps on the sea ice (Jenness 1922a).

Winter

The winter season lasted from approximately early or mid-December to mid-May. During this period, breathing hole sealing was the primary subsistence activity. Ringed seal (*Phoca hispida*) were the focal winter resource. Snow house settlements were constructed on new, smooth sea ice in areas suitable for seals. The Copper Inuit employed the method of waiting at the breathing hole and harpooning the seal when it surfaced for air (Jenness 1922a).

Group composition in settlements was flexible. A large number of hunters was required, however, to ensure community-wide success at hunting (Damas 1972a:14, 46). Damas (1972a:12) states that winter aggregations ranged from 50 to 200 people; Jenness (1922a:120) reports one village of 33 snowhouses and another of 16 families. Specific settlement locations were occupied for only two weeks to a month, after which entire group either moved together or split, with smaller family groups joining other settlements.

Spring

The spring season began in May. Then, winter villages were abandoned for skin tents on land. Stores of blubber and winter equipment were cached along the coast. This period was one of dispersement:

> Often the tribes partially break up as soon as their blubber caches are made, though the full disbandment does not take place till early summer. Many families even break off while the main body is still sealing on the ice, as there are many different hunting and fishing grounds, and every man is free to choose his own (Jenness 1922a:122).

Spring subsistence resources included a primary reliance on fish, especially Arctic char and lake trout; tom cod were jigged through the near-shore ice. Neither basking seals nor caribou were routinely hunted in spring. No tradition of stalking basking seals was present in the Copper Inuit region, although it was a common practice farther east (Boas 1974; Damas 1969b). Caribou were not hunted on their northern migration due to their poor physical condition (Jenness 1922a:123).

Summer

On Victoria Island, caribou hunting and fishing were primary activities in summer and fall. From mid-July to November, caribou were pursued to furnish both food and skins. They were hunted in organized drives using stone *inukhuit* fences or by stabbing them from kayaks when crossing streams. Less important food sources included a variety of birds and marmots (Damas 1972a).

The nuclear family comprised the basic summer social group, with additions of other individuals or family units. Hunting partnership were sometimes formed (Damas 1969b:49).

Fall

Caribou hunting continued into the fall period of late November. Char runs were important in late August, where they were trapped in stone weirs and speared with leisters. Aggregations of up to 50 individuals could occur at good fishing spots (Damas 1969b:45).

November was a "transition period" in the seasonal round between summer and winter pursuits (Jenness 1922a:110). At that time little subsistence activity occurred. Preparations were made for the movement onto the sea ice: all caribou skin clothing was assembled, sealing equipment repaired and caches of caribou, fish, and blubber from the previous spring collected. Groups of 30 to 100 individuals assembled at coastal meeting-places. Damas (1969b:52) states, "It is easier to imagine that the attraction of extending contacts outside the small grouping that had been the local unit during most of the preceding phase of the cycle [summer] was the chief motive for joining into larger groups [in November]."

Damas (1969a:127) stresses the importance of the nuclear family as the fundamental group in aboriginal Copper Inuit society:

> Copper Inuit family organization probably represented as close an approach as will be found to the isolated nuclear family attributed to the Eskimo in interpretive writings (Murdock 1949:227; Service 1960:747, 1962:99). Social structuring within the band was based largely on partnerships which seemed for the most part to operate independent of existing kinship ties.

This pattern contrasts with that of the Netsilik and Iglulik groups of Central Inuit, where the extended family was the principal household unit. In addition, an emphasis on non-kin based partnerships for food sharing and hunting were important unifying mechanisms (Damas 1969a).

Trade Relations

Based on observations made in 1910-1911, Stefansson (1914) described a system of trade relations between territorially discrete band units for scarce resources. This intra-band network functioned to redistribute products available only in local areas among Copper Inuit groups. The most important group in the network appeared to be the Kanghiryuakmiut of Prince Albert Sound who, "...had natural resources within the limits of their annual migration as a tribe, which must have formerly, even more than now, have made them nearly or quite the most prosperous tribe of the district we are considering". Important trade items included copper objects and,

> Since 1855 or thereabout M'Clure's abandoned ship the "Investigator" and her caches on shore in the Bay of Mercy on north Banks Island have helped the tribe to retain the mastery of the commercial situation locally. Though their last expedition to the wreck...was some fifteen or twenty years ago, articles of iron are even now more abundant and cheaper among them than among the more eastern groups who are nearer the present source of supply - Hudson bay (Stefansson 1914:17).

Trade was conducted by the Kanghiryuakmuit with other groups for steatite pots and lamps, caribou skins and wooden objects.

D. Material Culture

The most comprehensive discussions of Copper Inuit material culture are Jenness (1946) and Stefansson (1919). Information on and collections of material culture were obtained by Jenness during the Canadian Arctic Expedition before many features were lost or substituted by non-native items (see Jenness 1946:1; 1921a). Supplementary sources include Birket-Smith (1945) and McGhee (1972).

Copper Inuit material culture may be characterized as "typically Eskimo" in that a wide variety of task-specific items were employed. Mathiassen (1928:238) defined "Central elements" in Iglulik material culture which he considered characteristic of all Central Inuit. These included, among other things, ice-hunting implements, sledge and dog team, snowhouses, summer interior hunting and associated tools and weapons, caribou skin clothing and little decorative art.

McGhee (1972) provides a comparison of historic Copper Inuit and Thule material culture from the Coronation Gulf area. He finds continuity in the majority of material culture elements between the two periods. Changes include loss of items related to large sea mammal hunting; substitution of raw materials (stone, whale bone, ivory and clay pots) with other products (metal, antler, musk-ox horn and soapstone); and stylistic simplification in decorative motifs and manufacturing processes.

Raw Materials

Raw material resources from which the majority of material culture items were produced include wood, stone and minerals, metals, and animal products (horn, bone, skin, sinew, ivory and antler).

Wood was obtained either as driftwood along the coast or from the standing spruce in the valleys of major rivers (Jenness 1946:3). Wood was used to make a variety of objects: bows, arrow shafts, handles, household utensils, kayak frames and paddles.

Stone and mineral resources were principally soapstone for pots and lamps, and iron pyrites for striking fires. Historically, little use of slate or other stone for tool-making was known and no examples were found on the Copper Inuit sites considered here. Hearne (1958:108) reports the use of slate arrowheads by the Inuit massacred at Bloody Falls. Jenness (1946:124-5) observed only metal, bone or antler arrowheads and suggested that within one hundred years the older slate points had been completely replaced by other materials.

Steatite was obtained in the Tree River region (Jenness 1946:53). The Prince Albert Sound district was a major source for native copper with another source in the Coppermine River/Bathurst Inlet region (U.M. Franklin et al. 1981:4-5; Stefansson 1914:16-17). By the early twentieth century copper was used to make knife blades, adzes, drill bits, fish rakes, arrowheads and ice chisels (Cadzow 1920), although Jenness (1922b:90) observed that iron and steel tools were more common, and had replaced copper for most items.

> Even before the time of Captain Bernard's visit [in 1910] the Copper Eskimos had acquired a considerable amount of iron, but his extensive trading resulted in the total disuse of copper for harpoons and knives, although it persisted a little longer in arrows and in the implements employed in fishing. My scouring of the Dolphin and Union Strait and Coronation Gulf between 1914 and 1916 resulted in the finding of only one genuine harpoon with a copper point, one copper snow-knife, and three women's knives of copper; even these were no longer used by their owners.

Animal products of importance were caribou and seal skins for clothing and shelter, as well as bone, horn, sinew and antler. "The caribou and musk-ox supplied nearly all the bone that the Copper Eskimos required. There was hardly a bone in the two land animals that could not be turned to some purpose" (Jenness 1946:5). Among these purposes were skin stretchers and needlecases from leg bones; skin scrapers from scapulae; handles, toggles, pins and bows from ribs; and a wide variety of items of antler (see below). Ivory was a rare commodity due to the scarcity of narwhal and walrus in the Coronation Gulf region.

Caribou Utilization and Antler Availability on Banks Island

One of the most important land mammals to the Copper Inuit was the caribou. Caribou provided skins and antler, as well as being a summer and fall food resource (Jenness 1922a:102). On Banks Island, however, archaeological evidence indicates that few caribou were obtained. In 104

Copper Inuit sites surveyed by Hickey (1981:20) only 129 individual caribou are represented, in contrast to an estimated 2405 muskoxen.

The low numbers of caribou in archaeological sites may be related to low density in the area of human occupation. Today caribou are most numerous in the southern part of the island (Usher 1970:68). One important calving ground is located in the northeastern highlands, north of the Bernard River (Department of Indian and Northern Affairs, Land Use Information Map Series 1974). The area of nineteenth century occupation was centered on the Thompsen River drainage (Hickey 1981). Muskox are presently very densely distributed there, and were probably so during the nineteenth century, when they were the primary food source utilized by the Copper Inuit on Banks Island (Will 1984).

In contrast, caribou antler is a common component of Copper Inuit sites on Banks Island. To obtain antler as a raw material in the absence of caribou, the Inuit must have been collecting shed antlers. Shed antler may have also been preferred for its hardness, as indicated by a Greenland Native: "The antlers are not much bothered about. People prefer to use the shed antlers, which are the hardest" (A. Bertels cited in Grønnow et. al 1983:46). This inference is supported by observation of archaeological material. Worked antler with the pedicle still attached was collected from the study sites; 12 sections were recovered from the Kuptana site (PjRa-18), two from the Nasogaluak site (PgPw-3), and three from the Haogak site (PhPo-3).

Material Culture Items Produced from Antler: A Summary

Items in several categories of material culture were made from antler (see Hahn 1977; Jenness 1946). An inventory of Copper Inuit antler artifacts from the ethnographic period is presented in Table 1. Here material culture is classified into several categories: hunting and fishing equipment, transportation equipment, food preparation and household equipment, and ceremonial and personal adornment items. The inventory of material culture is based on Jenness (1946) and Birket-Smith (1945).

Antler as a Raw Material

The cycle of antler growth and shedding for Barren Ground caribou was described by Bergerud (1976). The onset of visible growth depends on the age, sex and physical condition of the individual animal. Antler growth is visible in adult males in April; barren females begin growth in May, and pregnant females in June. Adult males shed their antlers in late November and December. Pregnant females carry theirs through to June. They shed and commence new antler growth following calving. According to Bergerud, antler size is correlated with age, body size and winter snowfall.

The morphology of caribou antler is that of a single main beam from which accessory tines branch first anteriorly and then posteriorly (Bubenik 1972 and Figure 1). From the

Table 1. Inventory of Copper Inuit Material Culture Items of Antler*

Item	Description
Hunting and Fishing Equipment	
fishing rod	handle spliced to wooden rod or entire rod up to 18 in long
sinker (tomcod)	2.5-5 cm long, oval in outline, flat on 1 face and rounded on other; 2 drilled holes for line
sinker (cod)	longer than tomcod sinker
fish spear	3 barbed leister prongs
fish rake	beveled section of antler into which copper prongs are inserted; drilled at shaft end
seal harpoon	shaft often of 2 or more spliced antler sections riveted together; foreshaft of socketed antler; ice pick spliced and lashed to shaft
harpoon head	slotted blade end horizontal to line holes; butt cut obliquely to produce spur; circular drilled hole for foreshaft attachment
toggle for leading dog	variable in size; no decoration
toggle for hauling seal	5-10 cm from tip to tip; crescentic hole in center; often ornamented with incised lines
bow	infrequently made of sections of antler scarfed and riveted together; or plates of antler to stengthen joints of wooden bows
arrowheads	long antler points fitted directly into wooden shafts; 1 or more barbs or barbless
arrow foreshaft	oblique cut at shaft end with conical tang; 2 small projections for lashing
caribou lance	socketed foreshaft; split at base for wooden shaft and riveted
snow goggles	of wood or antler; usually no ornamentation

Table 1. Inventory of Copper Inuit Material Culture Items of Antler (cont.)

Item	Description
Transportation Equipment	
harness trace toggle	swivel pin knobbed in rear and slotted in front; inserted into square plaque with 1 large hole in center for swivel head and 4 smaller holes in each corner for trace
Tools	
women's knife handle	toggle-shaped handle; thin tang midsection with drilled attachment holes
men's knife handle	round slotted blade end; square-cut at butt end
snowknife handle	slotted blade end, butt end of riveted horizontal piece
whittling knife handle	2 short, slightly bent sections spliced and riveted together; blade end tapered; butt end cut square; drilled hole(s) at butt end
burin handle	antler handle of no specific shape; blade end slotted
adze handle	of 1-2 pieces, socket with drilled holes for blade and/or straight handle with drilled hole(s) for attachment
bow drill spindle	part or all of antler or wood; often with an antler shank for bit insertion
handsaw handle	curved handle square-cut at blade end with drilled holes for rivets; rounded at butt end; European copy
mattock or pick	any large antler, curved or straight, with sharpened point and shaped grip
snow sounder	straight, slender rod of antler ca. 1 m long shod at bottom with peg
Skin-working Equipment	
women's knife handle	knife smaller in size than large ulo
scraper handle	long forked handle; notch for forefinger sometimes cut into underside; rivet holes for bladel attachmen
awl	pointed tool of non-standardized shape, used to punch hole in skin

Table 1. Inventory of Copper Inuit Material Culture Items of Antler (cont.)

Item	Description
Food Preparation and Household Equipment	
fire drill	often handle of whittling knife; small holes made to fit spindle
Hunting and Fishing Equipment	
meat forks	slender, tapering pencils; slightly curved and flattened at broader end; 17-30 cm long
knife for chopping snow	roughly-made flattened section
Ceremonial and Personal Adornment	
belt toggle	same as toggles for hauling seals
comb	no longer than 10 cm; 5-7 teeth cut with grooving tool; drilled hole in end
scissors	copied from non-native prototype; tin blades and antler handles
carved objects	tiny, zoomorphic figures

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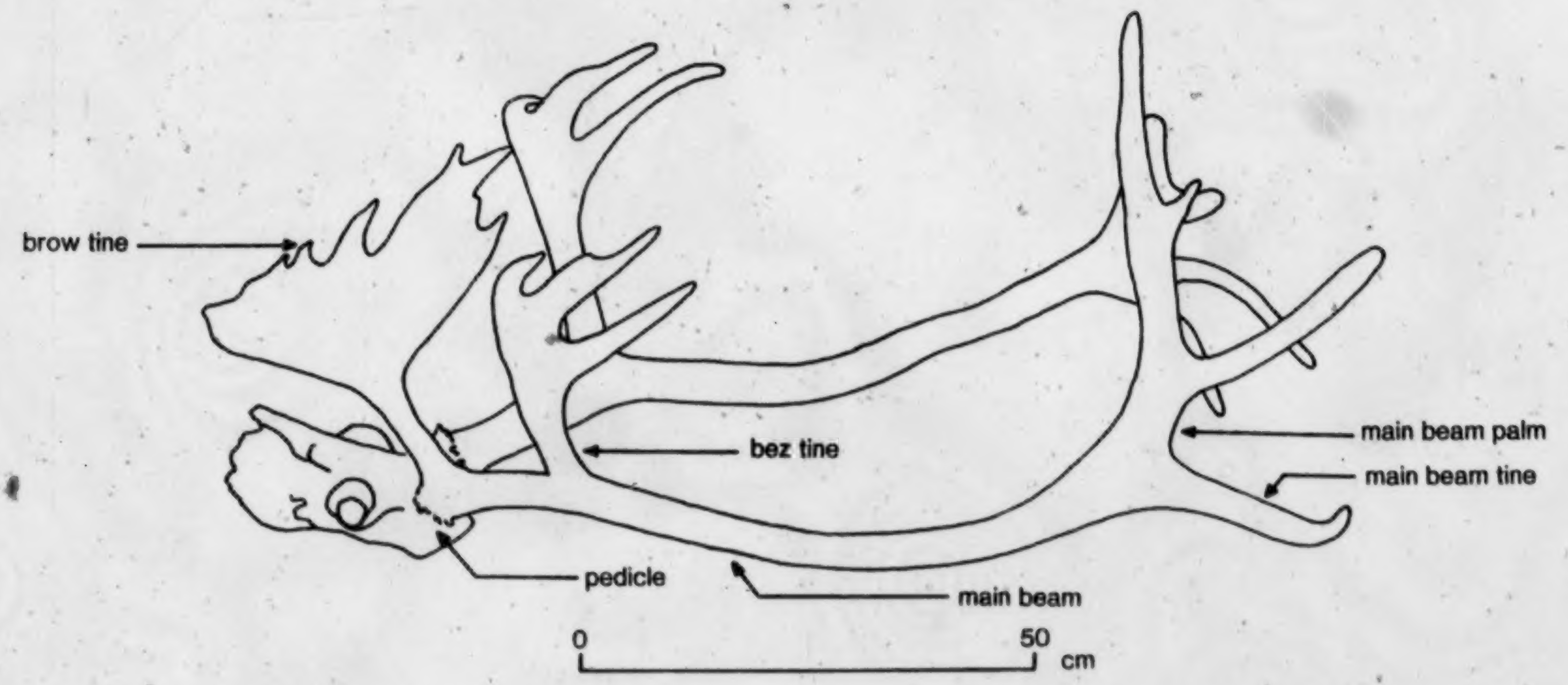
* The information presented in this table is from Jenness (1946), in which measurements were given in Imperial units.

perspective of antler as a raw material, this structure provides both rounded beam sections and flattened tines for blanks.

Penniman (1952) provides information on the structure of antler, based on microscopic observation of cross-sections. Elk, red deer and European reindeer antler were used in the study. Of most importance for consideration of antler as a raw material is its two-layer nature (Figure 2). It is composed of an outer compact layer and an inner spongy center. The interior cancellous tissue varies in diameter, depending on the animal's age, nutritional condition, and whether it has had a calf. Reindeer antler has a thick compact layer useful for producing thick artifacts (Penniman 1952:35).

Albrecht (1977) conducted tests on the physical properties of bone (cow long bone), stag antler, caribou antler (Peary caribou from Banks Island), elephant ivory and musk ox horn. Comparisons were made of the compressive strength and flexibility of the raw materials. The caribou antler possessed high compressive strength, exceeded only by ivory, and the highest flexibility rating of all materials.

In Table 2 measurements of antler size taken on a large, adult male Peary caribou are presented. The recent, natural kill composed principally of the skull and antlers was found near the Kuptana site, Banks Island. The presentation of this information is intended to provide an idea of the quantity of material which could be obtained by



brow tine
bez tine
main beam palm
main beam tine
pedicle
main beam
0
50
cm

Figure 1. Terminology of Anatomical Parts of Caribou Antler.

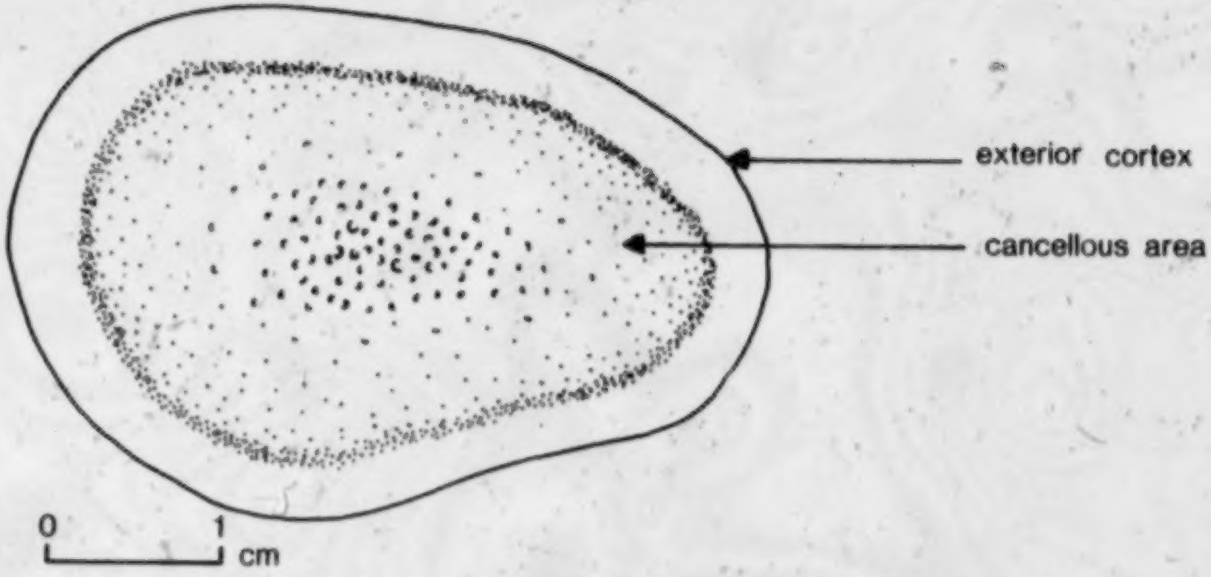

exterior cortex
cancellous area
0
1
cm

Figure 2. Structure of Antler in Cross-Section.

collection of shed antler, since other sources for antler raw material may not have been readily available on northern Banks Island when the archaeological sites were occupied.

Conclusion

Archaeological research in the Western Canadian Arctic was briefly discussed. It can be seen that continuity between Thule and historic Copper Inuit culture is now generally accepted, if not fully demonstrated. Continuity in material culture is more easily demonstrated although changes in raw material, stylistic motifs and manufacturing techniques are apparent (McGhee 1972).

In particular, raw material type changed with the introduction of metal trade goods. In Thule and Intermediate Interval assemblages, ground slate, chipped stone, antler and copper were used for knife blades, adze heads, arrowheads and end blades. By the ethnographic period, iron and steel were most common for knives, end blades, adzes and grooving tools. Copper objects were still being manufactured, but many were made only for sale to collectors (Jenness 1922b:90).

An ethnographic sketch of the Copper Inuit provides a general description of features of technology and material culture. Many items of material culture are comparable in form and, therefore, possible function. Ascriptions of function to archeological specimens relies, in part, on making an analogy with documented ethnographic examples:

Table 2. Measurement of Adult Male Caribou Antlers from Banks Island.

Measurement (cm)	Right	Left
beam length from pedicle to tine tips	92.0	112.0
beam length from pedicle to base of main palm	65.0	77.0
beam diameter at pedicle	4.6	4.2
bez tine length	33.2	30.5
bez tine width at intersection with main beam	4.5	4.2
brow tine length	-	32.0
brow tine diameter at intersection with main beam	-	3.3
main palm width at base of palm	13.0	10.5
main palm thickness	2.0	2.5

> To support assertions of function, archaeologists have long made use of analogical inferences from items of similar form, found in ethnographic situations where the functions of the ethnographic items are well known... Many items found in archaeological contexts are so similar to those used in ethnographic contexts that functions are attributed without hesitation... These functional ascriptions are based on inferences that seem to proceed from similar form to similar function in a very straightforward way (M. Salmon 1982:58).

Information on tool function and use is used in Chapter Three to form hypotheses about tools which could function to modify antler, and technological processes responsible for morphological features on archaeological specimens. The hypotheses are then tested experimentally, in order to link the behaviors and techniques to morphological patterns on artifacts.

III. THE EXPERIMENTS

Introduction

Replicative experiments are conducted in order to test some hypotheses about how antler was modified. The experiments are designed to be exploratory. The main goal is to say what tools and techniques might have been used to modify antler. Specific goals are to:

1) observe the utility of tool types and manufacturing methods described ethnographically for the Copper Inuit to produce morphological features like those on archaeological antler specimens;

2) compare the morphological features produced on antler by copper and iron or steel tools to see if copper (either native or imported) could be distinguished from the harder metals;

3) compare the 'workability' of metal tools on untreated and pretreated antler by using both soaked and dry, shed antler in experiments.

A. Hypotheses

Hypothesis 1

If tool types similar to those described ethnographically for the Copper Inuit were used to modify antler in the Banks Island archaeological collection, then similar morphological results will be produced by similar tools experimentally.

Test Implications

1. Burins will produce square-bottomed groove marks when drawn over the surface of antler sections. Whittling knives, when held and manipulated in the manner described by Jenness (1946, see below) will produce a surface with fine, linear striations. Adzes will remove large pieces of cortex from the antler surface, and hinges and notches will be created on the section, where the adze blade impacts at an angle. Circular holes will be produced by the action of a bow drill.
2. Because of the close temporal and cultural affiliation of the Banks Island archaeological collections and ethnographic Copper Inuit collections, similar tool types as those described ethnographically are expected to be found in archaeological site assemblages, where such items are present.

Discussion

The use of the above mentioned tools is suggested by analogy with recorded Copper Inuit material culture (see below). In addition, some of these tool types have been recovered from Copper Inuit archaeological sites on Banks and Victoria Islands (see Table 3). The suggested function of the artifacts listed in Table 3 is based on their similarity in form to ethnographic descriptions of Copper Inuit tools (Jenness 1946).

Table 3. Antler-Working Tools from Copper Inuit Archaeological Sites, Banks and Victoria Islands.

Tool	Site	Reference
grooving tool, iron blade	Haogak Site	
grooving tool, iron blade	Haogak Site	
grooving tool	Isachsen Sands	Hahn 1977
whittling knife	Isachsen Sands	Hahn 1977
chisel or adze	Isachsen Sands	Hahn 1977
grooving tool, iron blade	Kunana Site	McGhee 1972
composite whittling knive and grooving tool, copper blades	Kunana Site	McGhee 1972
engraving tool, copper blade	Kunana Site	McGhee 1972

Ethnographic Descriptions of Copper Inuit Tools and Technology

The three major sources for ethnographic information on Copper Inuit material culture and technology are Stefansson (1919), **The Stefansson-Anderson Arctic Expedition: Preliminary Ethnological Results**, Birket-Smith (1945), **Ethnographical Collections from the Northwest Passage**, and Jenness (1946), **Material Culture of the Copper Eskimos**. These three works provide a comprehensive description of early twentieth century Copper Inuit material culture; they were consulted for information on types of tools, tool design and the manner in which tools were held and manipulated.

Jenness (1946:5) presents a description of the tools used to modify organic materials:

> Originally the Copper Eskimo used only four tools, all with copper blades, for shaping bone, antler, and horn, viz., the adze, the whittling knife, the grooving tool, and the drill. In our time nearly all these tools had steel or iron blades, and a fifth had been added, a small saw with a blade of hoop iron. Saws were not numerous, however, and it was still a common sight to see a native scouring deep cuts in bone or antler with his grooving tool and then breaking out sections with his adze. The curved whittling knife gave the final shape, and rubbing, first with stone or sand and then with a strip of hide, the smoothness and polish.

Whittling knife. Stefansson (1919:102) refers to this tool as a 'crooked knife'. Birket-Smith (1945:205) describes it as a pointed single-edged blade fastened by rivets to a curved antler handle. All specimens illustrated possess iron blades; Jenness (1946:98) reports that copper was replaced by hoop iron for blade manufacture. Jenness (1946:101) also presents a description of how the tool was used:

> The Copper Eskimo held the knife lowdown with the hand directed inward, and the handle resting along the inner side of the forearm so that it fitted into the curve of the elbow. With the instrument thus pivoted on the elbow the forearm moved as a unit and the wrist remained perfectly still. Smaller whittling knives, even though their handles did not reach the elbow, were held in the same manner.

Stefansson mentions that the blade was sharpened on one edge, scissor-fashion, and was made of either iron or copper.

Grooving Tool. The grooving tool was used "...for cutting grooves in bone, antler, and horn...The blade was nicked at one end or else bore a sharp pointed projection" (Jenness 1946:101). All four burins illustrated by Birket-Smith (1945:105) possess iron blades and antler handles. Stefansson (1919:107) pictures a copper-bladed burin. Jenness (1946:101) reports, "All three specimens [which he illustrates] have iron blades as indeed did every grooving tool I saw... whether copper or stone preceded iron...I did not discover."

Adze. The explorer Hearne (1958) described Copper Inuit adzes seen at the Bloody Falls campsite. The adzes were of copper, about 15 cm long by 5 cm wide, attached to antler handles. By the twentieth century, few adze blades were produced from copper (Jenness 1946). Both Jenness and Birket-Smith illustrate adzes with blades produced from steel chisels or files. Birket-Smith describes two hafting methods. In one case the blade was lashed directly onto and parallel to an 'L-shaped' antler handle. In the other method, the blade was mounted at an acute angle in a head or socket of wood or antler, that was in turn lashed to an antler handle. Jenness reports that the adze was used to chop material in the manner of an axe.

Drill Set. The Copper Inuit used the bow drill, rather than the hand drill to produce circular holes. Stefansson described a typical drill set consisting of a muskox rib bow, caribou astragalus mouthpiece, and spindle of caribou, muskox or bear bone. The drill bit was usually of iron, occasionally of copper. A broken needle was used to drill the eyes of needles. Birket-Smith illustrates three drills, all possessing iron drill bits. Finally Jenness (1946:101) reports, "All the drills I saw had points of iron, which had long been current in very small quantities; copper perhaps was used earlier, and stone, although the natives seemed to have no recollection of the stone drill points."

Saws. Both Birket-Smith (1945:207) and Stefansson (1919:107) illustrate small saws (about 25 cm long) made with irregularly-toothed iron blades riveted to antler or wooden handles. Birket-Smith reports that these tools were made from a European pattern. Wissler (1924:118) describes saws and sawn antler and ivory material from Polar Inuit sites in Western Greenland:

> Of the three processes named [cutting, sawing and drilling], sawing is undoubtedly recent, since it can only be executed in the manner observed in the collections by the use of a metal saw. Some of the objects from each of the localities represented give evidence of having been worked by sawing. In some

> cases, the trial saw cuts of the native workman are still to be seen. There are of such a form and size as to preclude the possibility of the use of any other implement save a modern steel saw...Anyone familiar with Eskimo collections will recall frequent examples of saws, in many cases, of native manufacture. The usual form is a small blade of trade steel, the teeth for which have been produced by filing, hafted with a curved piece of antler somewhat like the handle for the ordinary carpenter's saw.

Experiments with replicated saws were not conducted. It was assumed that saws obtained by the Inuit from the Mercy Bay cache would not differ significantly in shape, other than gross size, from saws currently available. The author had ample opportunity to observe the results of sawing antler in preparing sections used in the experiments. A small handsaw with a 20 cm blade was used in sectioning some pieces (see Plate 8, page 76, for an example). Finally, some documentation for the results of sawing bone is available (Semenov 1964:153; Wissler 1924, cited above).

Hypothesis 2

Because copper is a softer metal than iron or steel (Franklin et.al. 1981), it may leave different morphological features on an antler surface, when used as a tool.

Test Implications

1. The iron and steel tools will remove more material from the antler surface than the copper tools, with the same application of force and number of strokes.
2. Different morphological features will be present on the pieces modified with copper tools than with iron or

steel tools. These characteristic features can then be used to differentiate raw materials used to modify antler.

Discussion

Some metal for tool-making was available to Copper Inuit prior to the salvaging of the *Investigator* cache. Native copper was obtained from local sources on Victoria Island and the Coppermine River/Bathurst Inlet region (U. M. Franklin et. al. 1981:4-5; Jenness 1922a; Stefansson 1914). In addition, some trade metal had been brought into Arctic Canada from Asia as early as the first millenium A.D. (Semenov 1964; U. M. Franklin et al. 1981; Hickey 1979b) and from Norse Greenland by A.D. 1000 (McCartney and Mack 1973). How much of these resources were available to and used by Copper Inuit is unknown. By the post-1910 ethnographic period copper had been replaced by iron and steel for many tools. Jenness (1946:97,98,101; 1922b) indicates replacement of copper blades in knives, grooving tools, and drill bits. Given that iron was present in comparatively larger quantities from the Mercy Bay cache, the replacement process may have occurred during the salvage period of the late nineteenth century.

Review of Relevant Literature

While experiments have been conducted to compare stone and metal tool for working bone and antler (Blaylock 1980; Walker and Long 1977), none have been designed specifically to compare iron/steel and copper.

Blaylock's (1980) replicative experiments were designed to compare metal and stone blade raw materials for working caribou antler and whale bone. Iron, copper and stone (including chert, shale, and diabase) blades were employed to groove, chop, cut, whittle, and drill sections of bone and antler. Blaylock (1980:140) concluded that, "...the results reported ... indicate that metal, chert, and diabase blades each produce contrasting mark characteristics which could be used to tentatively identify whether metal and/or stone bladed tools might have been used to manufacture Thule artifacts."

Metal burins produced deeper grooves than those made by a chert burin-like tool. No overall difference in groove depth was noted between two iron burins (one claw-shaped, one flat) and a copper burin. On antler the iron blade produced "...a deeper, straighter, and more clean cut groove than the chert blade, in the same amount of working time" (Blaylock 1980:144).

Iron and diabase adzes were compared by Blaylock (1980) for chopping antler and whale bone. The iron adze made sharp, clean cuts on both materials. Notches produced in the surface were thin and sharp. The diabase adze tended to mash the surface, thereby producing ragged cuts; notches were shallower than those made by the iron adze.

Blaylock (1980) used iron, copper and chert blades for whittling. The results indicated that stone was less effective than metal for working the material. Longer, thicker and larger parings were produced with metal blades.

An experiment to compare cut marks tested chert, iron, and copper knives. The cuts produced by the chert knife were crooked, thick, shallow, and jagged. Those made by the metal blades were straight, thin, deep and clean cut. Differences in blade thickness and smoothness were related to features produced on bone and antler (Blaylock 1980).

Walker and Long (1977:605) attempted to establish correlations between edge characteristics of tools and the marks they produced on bone. Cow metapodials were incised with bifacially flaked obsidian blades, a steel knife and a steel axe. The bones were mounted on a platform scale to measure and maintain a constant load during the cutting procedure.

Examination of the cuts produced indicated that "tools such as steel knives, steel axes, and obsidian flakes with unmodified edges produce V-shaped grooves with straight sides that meet in a distinct apex at the bottom of the groove" (Walker and Long 1977:608). Stone tools made wide irregular grooves with concave sides. They also found that pressure and angle of application, blade length, and motion used in the cutting process were variables important in determining the morphology of tool marks.

Hypothesis 3

It has been demonstrated in other experimental research (Blaylock 1980; Bonnichsen and Will 1980, among others) that pretreatment softens antler and makes it more amenable to modification with **stone tools.** Since metal tools were available to the Copper Inuit, was pretreatment necessary for working antler with metal tools? If pretreatment was not necessary, then metal tools should modify untreated, shed antler as easily as pretreated antler.

Test Implication

1. With the same number of strokes of the copper, iron and steel blades, using relatively equal force, the same amount of cortical will be removed from the untreated and pretreated antler sections.

Discussion

Experimental results and ethnographic documentation demonstrate that pretreated antler becomes quite elastic, and may be bent to a shape which will be maintained once it is dried (Osgood 1970; Semenov 1964). Bonnichsen and Will (1980:14) suggest that pretreatment affects a softening of the collagen fraction, rather than the apatite fraction of bone.

Few ethnographic descriptions of pretreatment are available. Boas (1974:524) described Cumberland Sound

(Baffin Island) Inuit practices: "If wood is to be bent into hoops or deer horn is to be straightened, it is made pliable by being put into boiling water for some time." Osgood (1970:93) reported that Ingalik Athapaskans soaked caribou antler in water for five days in order to split it. The Koryak (Jochelson 1908:647) softened antler by soaking it in urine. Semenov (1964:160) described a Russian peasant method of softening bone by steaming it in wet hides. Finally, Skinner (1909:22) provided a description of Abenaki [Natives of New England] pretreatment: "...Abenaki in general, always boiled antler for a very long time before attempting to cut it, and that this boiling reduced the antler to such a consistency that while hot it 'cut just like cheese'".

Replicative experiments conducted by archaeologists have demonstrated that organic material soaked in liquid absorbs it, and thereby becomes soft (Bonnichsen and Will 1980:17). Bonnichsen and Will soaked dried bone and antler sections in three mediums: rain water, sea water, and urine. Each specimen absorbed liquid, as reflected by weight gain; absorption peaked on the fourth day of soaking. Subsequent modification experiments indicated that both soaked antler and bone could be incised to greater depths than could their dry counterparts. The soaked antler was sawn with a chert biface to a depth almost six times greater than a dried section. Soaked bone was incised twice as deep as dried bone.

Blaylock (1980:120ff) conducted pretreatment experiments modeled after those of Bonnichsen and Will (1980). She compared relative absorption of water by dry and green whale bone, and caribou antler. Samples of each material were either soaked in water or placed in a humid environment for four days. A control sample was left untreated. Her results indicated that green whale bone absorbed more liquid when soaked, while caribou antler absorbed more in a humid environment. The difference between raw materials in amount of water absorbed was not great (see Blaylock 1980:graphs 1-3).

Blaylock also used Brinnell Hardness Tests to corroborate the results of pretreatment experiments. In this experiment, a weight of known mass was dropped on to each sample. The size of the indention produced provided a means of quantifying material hardness. The outcome demonstrated that softening had occurred as a result of pretreatment. Soaked antler was demonstrated experimentally to be more conducive to some manufacturing processes:

> The combined results indicate that generally the untreated raw materials [whale bone and caribou antler] were difficult, and sometimes not possible, to work with certain manufacturing processes (i.e., grooving, chopping (shaping), and whittling), with the exception of caribou antler where chopping (shaping) was possible (Blaylock 1980:135).

B. Experimental Design

The hypotheses and discussion presented above serve to provide a basis for design and execution of the replication experiments. In each case, an attempt was made to present a rationale for the experiments (eg. choice of materials, variables selected, and methods and procedures). The rationale is derived from observation of collected archaeological specimens, analogy with ethnographic Copper Inuit material culture and relevant literature on experimental bone technology.

In the following section, the experiments will be described in detail. Four experiments were conducted:

1. Grooving with burin-like tools (Plate 1).
2. Scraping and whittling with whittling knives (Plate 2).
3. Chopping and chiseling with adzes (Plate 3).
4. Drilling with a bow drill (Plate 4).

Materials

In each experiment, samples of untreated and pretreated antler were modified with iron and copper tools. This procedure was followed in order to test whether different morphologies were produced by the same tool on untreated and pretreated antler. It also presented an opportunity to qualitatively evaluate the ease with which soaked and dry antler could be worked.

Shed Peary caribou (*Rangifer tarandus pearyi*) antler from Banks Island was collected by the author for use in the

Plate 1. Grooving Experiment.

Plate 2. Scraping and Whittling Experiment.

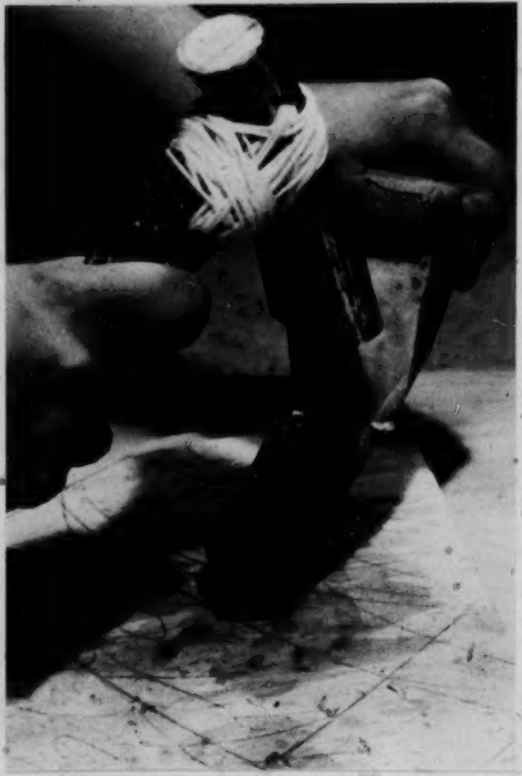


Plate 3. Chopping Experiment

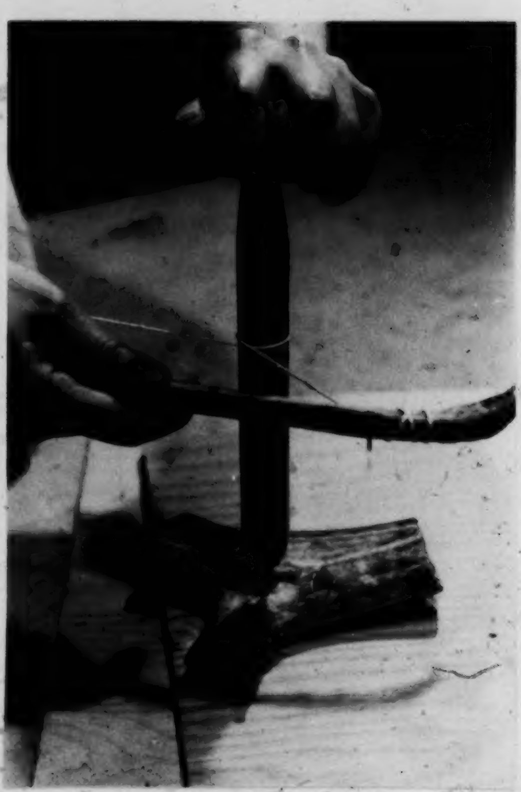


Plate 4. Drilling Experiment.

experiments. In addition, Tom Andrews, Department of Anthropology, University of Alberta, also provided shed barren ground caribou (*R. t. tarandus*) antler from Old Crow, Yukon Territory, which he estimated to be from 2-4 years old. The antler collected on Banks Island was of unknown age. However, due to its good condition (i.e. little damage from rodent or canid gnawing) it was probably only one to two years old.

The tools were made by Richard Will and the author from scrap metal. The blades were produced to resemble ethnographic specimens in shape, length and edge characteristics (the Hornby Collection housed at the University of Alberta, and written descriptions: Stefansson 1919; Birket-Smith 1945; Jenness 1946). A modern steel adze, contributed by Dr. Hickey, was used for the chopping experiment, since all ethnographic descriptions were of steel-bladed adzes (refer to the discussion of adzes above).

While blade edge features were reproduced as closely to original collections as possible, handles were produced from materials at hand. The bow spindles, for example, were made from pine doweling; the burin, knife and adze handles were produced from sawn and drilled mule deer, elk and caribou antler.

Methods

Methods used in the experiments included pretreatment of one half of the antler sections, incising each section a predetermined number of strokes with each tool, photographing the tools and modified sections, and videotaping each experimental procedure.

The pretreatment procedure used by Bonnichsen and Will (1980) was followed because (1) their results indicated that absorption rates peaked after four days, and declined thereafter and (2) soaking, rather than boiling, accounted for maximum liquid absorption. Since the aim of pretreatment was not to test various softening methods, but to compare pretreated and untreated samples for kinds of modifications induced on them, only one method, soaking, was used.

Sections were selected for pretreatment which were of approximately the same weight and shape as the control samples. All pieces were sawn to 15 cm lengths. The sections were submerged in tap water in covered containers. Water temperature was maintained at room temperature (ca. 21°C). The process was monitored every 24 hours for water absorption.

A thirty minute video-tape was made of the experiments. This method of documentation was selected so that a full record of each procedure, and its results, could be made. Assistance in videotaping was provided by Dr. David Young, Department of Anthropology, The University of Alberta.

Experimental Procedure

All of the experiments were conducted by the author to allow reasonable control over application of force, the way each tool was held, and the manner in which each section was modified. An attempt was made to standardize each test, however no mechanical means were used to maintain constant pressure application. In these experiments, the independent variable was either blade raw material or condition of the antler section. The morphology produced on the pretreated vs. untreated antler sections was the dependent variable. It was assumed that incision depth, for example, would vary with force applied. The author had little information concerning the manner in which tools were held by Copper Inuit tool makers, therefore the tests were designed specifically to look at morphological results of modification.

Untreated and pretreated sections of antler were each modified a predetermined number of strokes with a given tool, and the same number of strokes were appled for each blade raw material. This information is summarized in Table 4. Experimental results are discussed in the next section.

C. Experimental Results

Experiment 1: Grooving

Trial 1A. In this trial, the iron grooving tool was drawn across a beam section of soaked antler for ten strokes. Difficulty arose in initiating and maintaining an even force along the groove. The short section was hard to hold, especially when force was applied near either end. However, once a shallow line was scratched on the surface, a

Table 4. Summary of Experiments.

Experiment	Process	Materials	Tool Type	Procedure
1	grooving			section incised. 10 strokes
A		pretreated section	iron burin	
B		same	copper burin	
C		untreated section	iron burin	
D		same	copper burin	
2	chopping			section chopped on angle. 10 strokes
A		pretreated section	steel adze	
B		same	copper adze	
C		untreated section	steel adze	
D		same	copper adze	
3	whittling/ scraping			blade held 90 degree angle. 10 strokes
A		pretreated section	iron blade	
B		same	copper blade	
C		untreated section	iron blade	
D		same	copper blade	
4	drilling			section drilled. 10 circular strokes
A		pretreated section	iron bit	
B		same	copper bit	
C		untreated section	iron bit	
D		same	copper bit	

straight groove could be produced. Characteristic features of the groove were a square bottom, sharp edged and long thin parings of by-product material were produced. A groove 1mm wide and 1.4mm in maximum depth was created after 10 strokes (Plate 5 A).

Trial 1B. The copper-bladed grooving tool was employed in this trial, in a manner similar to that in Trial 1A. Again, the greatest difficulty was in maintaining a smooth stroke. The groove produced was more crooked than in Trial 1A. The debitage of this activity were very short, thin curls of cortical tissue (Plate 5 B).

Trial 1C. Here, the iron burin was used to groove a dry antler section. Two attempts were made to modify different sections. In the first test, the antler piece possessed a hard, smooth surface on which no incision could be initiated. A second section was selected with a more convoluted surface. The convolutions were natural grooves of the impressions made by vascular canals present in the velvet during growth (Macewen 1920). It was still extremely difficult to make a straight groove. The blade tended to slide laterally and numerous scratches were produced which angled off from the main groove. An incision of negligible depth was made (Plate 5 C).

Trial 1D. The copper burin made a groove very similar to that of Trial 1C. Only a shallow, wavy groove could be created. Again, thin scratches angled off from the main groove (Plate 5 D).

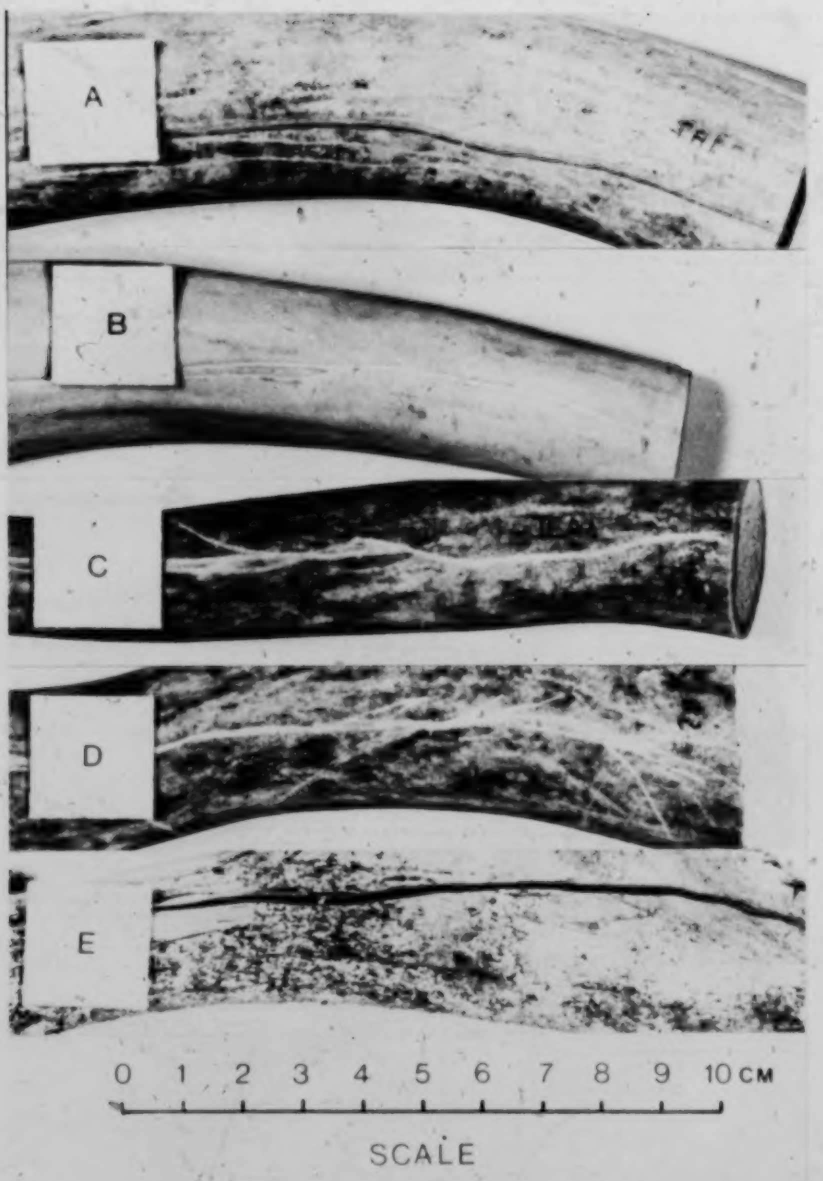

A
B
C
D
E
0 1 2 3 4 5 6 7 8 9 10 CM
SCALE

Plate 5. Results of Grooving Experiment: A. iron blade on pretreated antler, B. copper blade on pretreated antler, C. iron blade on untreated antler, D. copper blade on untreated antler, E. archaeological example.

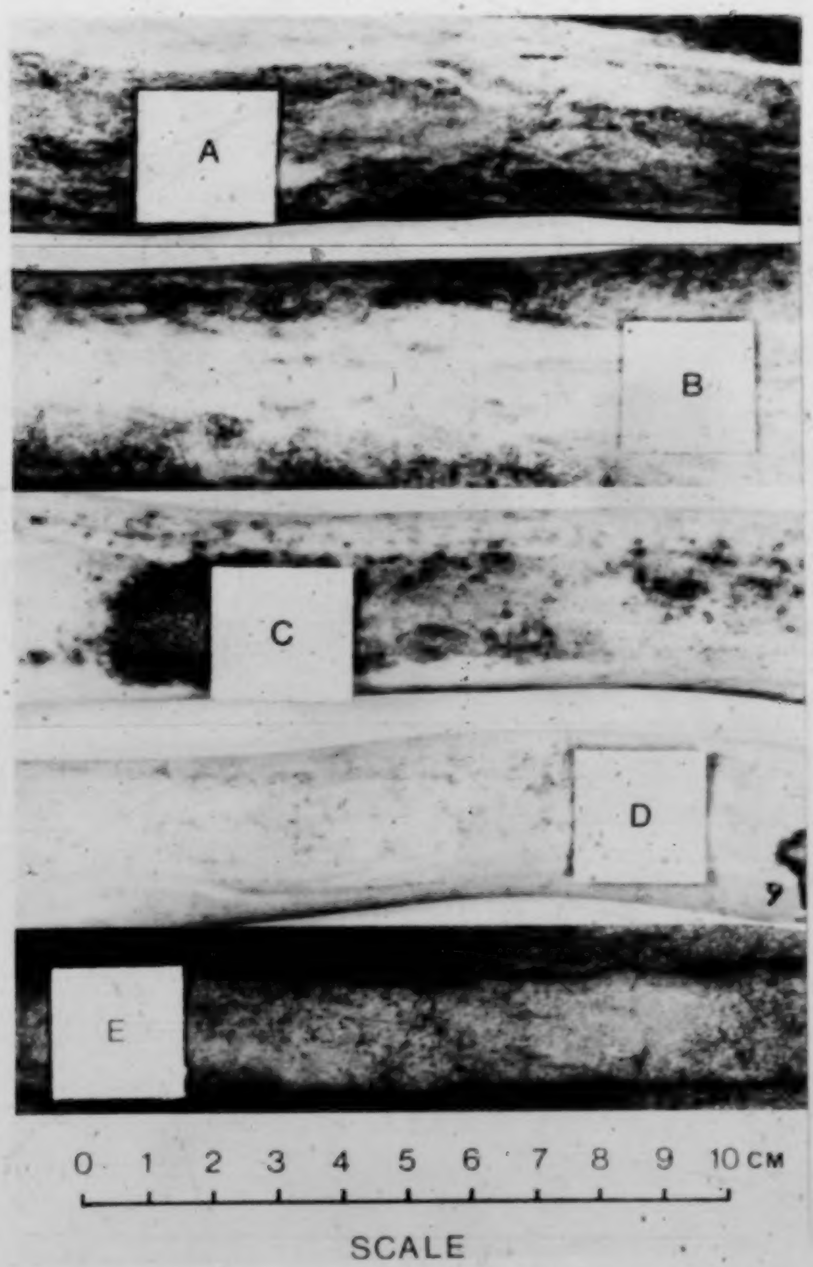
Experiment 2: Whittling

Trial 2A. The iron-bladed whittling knife was employed in this trial to whittle or scrape the surface of a pretreated section. Ten strokes were applied; the blade edge was held at an approximate 60 degree angle to the surface, in the fashion described earlier. The process resulted in long thin shavings being removed (Plate 6 A). A faceted surface demonstrating very fine linear striations observable under 6.3 X magnification was created.

Trial 2B. In Trial 2B the whittling knife with a copper blade was used. Short curly shavings were made as debitage and a very thin layer of cortical bone was removed from the modified surface (Plate 6 B). Under microscopic examination, no distinctive patterns could be seen, other than a roughened surface.

Trial 2C. Here, the iron knife was scraped across the surface of a dry section. A fine dust of shavings was removed, however very little change was observed on the antler (Plate 6 C). It was difficult to maintain a steady application of force for the duration of the stroke; the blade appeared to "jump or chatter" along the surface, perhaps due to unevenness in either the blade edge or the outer layer of antler.

Trial 2D. The copper whittling knife produced very little alteration to the dry antler section in this trial (Plate 6 D). Under 6.3 X magnification, very fine scratches could be perceived on the outer compact tissue. The


A
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10 CM
SCALE

Plate 6. Results of Whittling/Scraping Experiment: A. iron blade, pretreated antler, B. copper blade, pretreated section, C. iron blade, untreated section, D. copper blade, untreated section, E. archaeological example.

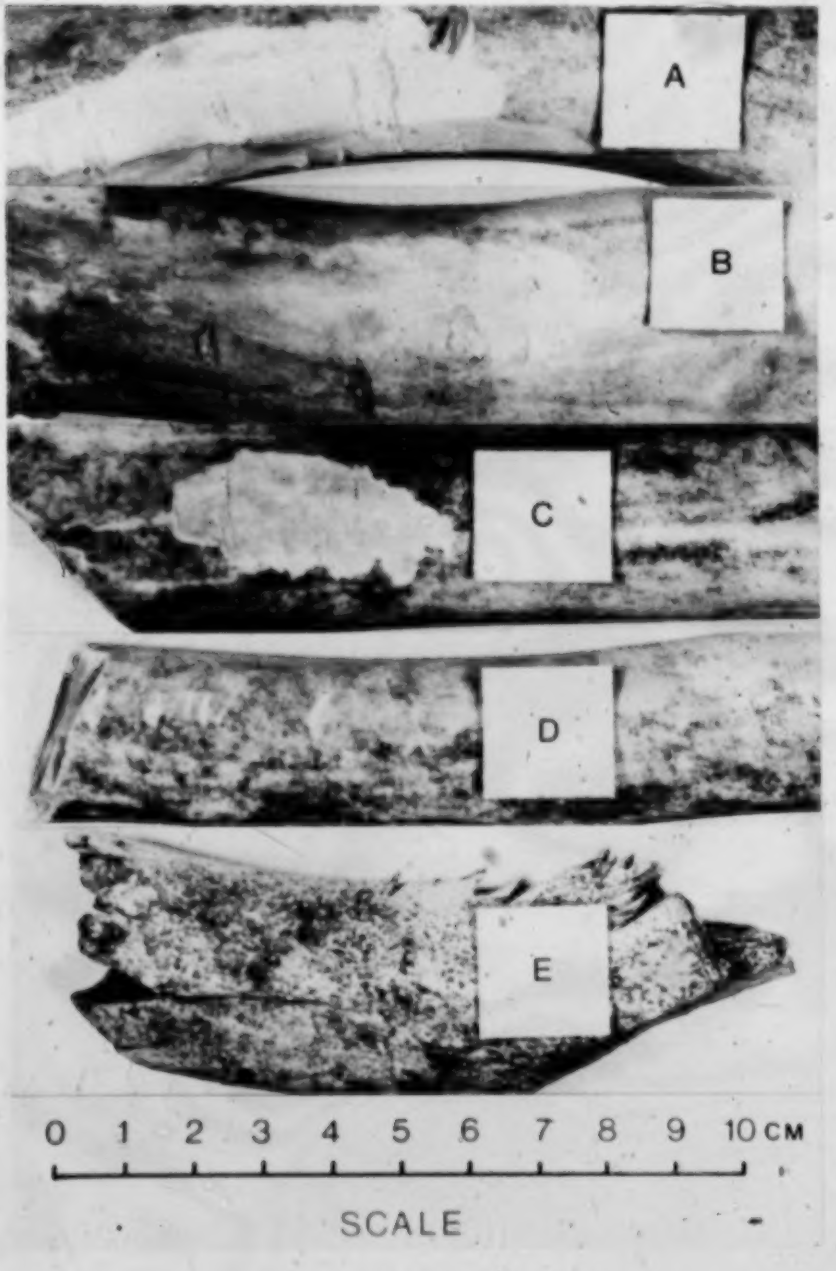
by-product of this process was a fine powder. Like Trial 2C, it was difficult to maintain a smooth motion across the surface of the piece.

Experiment 3: Chopping

Trial 3A. In this experimental procedure adzes were used to chop both soaked and dry antler (Plate 7 A). Trial 3A entailed the use of a steel adze to chop pretreated antler. The beam section was held roughly perpendicular to the floor and incised at a 30°-50° angle. Short thick parings of compact tissue were chopped from the piece by this process. Hinges were characteristically left on the chopped surface where short angled cuts were made.

Trial 3B. The copper adze blade was used in this case to modify soaked antler. In two cases where this modification was tried, different results were observed. In one attempt, the copper blade closely replicated the morphology produced by the steel tool (Plate 7 B). In the second case, however, only small surface chips could be chopped from the antler. It is suggested that differences in the hardness of the antler accounts for the variation between tests.

Trial 3C. The steel adze was used to chop dry antler in this case (Plate 7 C). Sharp "shards" of cortex were chipped away from the surface. Because of the brittleness of the dry antler, little control of the manner in which flakes of bone were detached could be exercised. However modification was


A
B
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6
7
8
9
10 CM
SCALE

Plate 7. Results of Chopping Experiment: A. steel blade on pretreated section, B. copper blade on pretreated section, C. steel blade on untreated section, D. copper blade on untreated section, E. archaeological example.

possible. A good analogy for the difference between chopping dry and soaked antler may be the comparative ease with which a very hard wood and a soft wood may be carved.

Trial 3D. The copper adze blade was extremely ineffective in working dry antler. The blade tended to rebound from the surface without any significant modification. Tiny crescentic chips were removed from the antler (Plate 7 D).

Experiment 4: Drilling

Trials 4A - 4D. In this experiment, iron and copper bits were used to drill first soaked and then dry sections of antler. In all cases, it was difficult to hold the bit in place, begin drilling and maintain steady pressure. Once an initial perforation was made, all the bits were effective. The manufacturing by-product was a fine dust. (No plate is provided, due to difficulties in photographing the faint, small holes.)

D. Evaluation of Hypotheses

Hypothesis 1

The results of Experiment 1 demonstrate that tools similar to those described ethnographically could produce at least some of the morphological features present on archaeological material. The following are the tools and associated features:

1. grooving tool - straight square-bottomed grooves; long

thin parings are produced as debitage;

2. whittling knife - faceted surface of fine parallel striations; by-product material is thin curly shavings;
3. adze - deep, "vee"-shaped incisions and hinges; short thick parings or wedges are the by-product of this activity;
4. bow drill - regular round holes; fine dust is created as debitage.

Hypothesis 2

Hypothesis 2 states that different morphological features may be produced by copper and iron or steel blades, due to different hardness values of metal tools.

In the experiments, copper and iron knife blades, grooving tools, and drill bits; and copper and steel adzes were compared for performance on both soaked and dry antler. The experimentally modified pieces were then examined macro- and microscopically for features which might be related to differences in blade raw material. Intuitively, it was expected that the harder steel and iron blades would more easily work the antler.

The results indicate, however, little difference between the two metals in either performance or modification characteristics. The copper blades were as effective as iron in modifying soaked antler. Both metals were generally ineffective for working dry antler. A difference was noted in the chopping experiment. The steel adze was able to chop dry antler whereas the copper blade was inadequate. The short duration of all experimental tests may also be a factor. The copper blades tended to dull more quickly, and in long-term use might require frequent resharpening. This result is probably due to the softer properties of the copper.

Hypothesis 3

The third hypothesis concerns whether pretreatment is necessary for working antler with metal tools. The workability of soaked and dry antler was compared in separate tests of each procedure by observing morphological featues produced, and the amount of raw material removed from antler section by ten strokes.

The results indicate that in three of the four experiments conducted, pretreatment was necessary for successful alteration of the material. In the grooving, whittling and chopping experiments, with one exception, the dry antler was extremely difficult to work. The iron and copper blades tended to slip on the hard cortex, rather than penetrating it. Conversely, the soaked antler was effectively worked in all cases, with both metal blades. The one exception was chopping dry antler with a steel adze blade. In that test (labelled 4C) the adze blade was moderately effective in chipping away cortex material, however control over shaping was limited.

Only in the drilling experiments were the results equivocal. A great deal of difficulty was encountered in maintaining the drill bit perpendicular to the antler surface and drilling with steady pressure. However, once a perforation was started, drilling was successful in all four trials (pretreated antler, iron [4A], copper [4B]; untreated antler, iron [4C], copper [4D] bits). It is tentatively suggested here that pretreated antler may be less desirable for drilling. The softened material may tend to reduce friction between the bit and surface so that drilling effectiveness is reduced. The results presented here tend to confirm other experimental literature that pretreatment is a desirable procedure to facilitate certain manufacturing processes.

Summary of Inferred Technological Processes

The potential number of processes that could be used to modify a piece of antler and thus produce a finished artifact is conceivably great. The different techniques used in any case would be dependent on materials at hand, objectives of the tool-maker, his or her competence and the body of cultural knowledge concerning the technology. Here, a limited number of technological processes were tested. The choices were made by reference to ethnographic analogues and similar research studies. The processes are: 1) grooving, 2) whittling and scraping, 3) chopping, 4) sawing and cutting and 5) drilling. Within each processing category several manufacturing techniques have been defined. These techniques are recognizable from the morphological attributes they produce on raw material, and are described in Chapter Four.

Grooving

Grooving is conducted with a sharp grooving tool, or burin. "The essence of the [groove and splinter] technique was to remove longitudinal splinters from the beam by cutting parallel grooves through the hard outer wall of the antler and forcing out the intervening portions" (Clark and Thompson 1953:148). The grooving tool is held at approximately a 90° angle and drawn towards the body. Long, thin parings are removed by a metal blade, and square-bottomed incisions are created (see Semenov 1964:156).

Splinters are then wedged or cut out. Examples of both processes are described in the literature on bone technology. Clark and Thompson (1953:149-40) suggest that wedges were used to force splinters from red deer antler recovered from Star Carr. An alternative procedure tested by Thompson was to undercut the splinter near the middle and then cut through the spongy bone with a thread pulled back and forth. Jenness (1946:6, quoted above) describes the use of an adze to break out splinters from the bone.

Whittling and Scraping

These two processes have been considered together because in the literature little difference has been noted in either their effectiveness or resulting morphologies on raw material. Newcomer (1974) used a scraping or planing technique to experimentally replicate bone tools from Ksar Akil, Lebanon. Semenov (1964) describes the mophology produced by whittling as parallel lines slightly wavy and at closely spaced intervals. In Experiment 2, shavings were removed from sections, leaving a striated or roughened surface.

Chopping

Chopping was accomplished with an adze. Chopping is used to reduce pieces by severing side tines and pedicle and for surface modification. Notches are created on the surface. Wedged-shaped splinters are produced as by-product, as suggested by results of Experiment 3. Similar kinds of debitage was recovered at all three study sites, which may indicate that some secondary modification was accomplished by chopping with an adze (implications of this occurrence for the site sample are considered in Chapter Five).

Little documentation for this process is presented in bone technology literature. Semenov (1964) states that stone axes were used at the Upper Paleolithic site of Kostenki I to transversely chop bone. Blaylock (1980:42) described the morphology of chop marks made by a metal adze blade on whale bone and antler as notches, roughened areas and multiple or individual lines.

Sawing and/or Cutting

These techniques have been also categorized together because of the similarity of form and placement of the residual marks. The term 'cut mark' (see attribute list, Chapter 4) was employed as a general descriptive term for incisions observable on material, without making assumptions about the kind of tool or process responsible.

It is suggested here that knife cut marks and saw marks are discernible. Saw marks are more similar to square-bottomed groove marks in morphology, but produce a smooth severed surface (Plate 8). Another criterion used to identify remnants of saw marks was the location of the mark. Sawing is most common on the ends of beam sections, where it was probably used to section them quickly through the long axis. Groove marks, in contrast, occur running parallel to the long axis of the beam sections.

Semenov (1964:153) illustrates a micro-photograph of a sawn bone; the cut end possesses numerous fine striations arranged in parallel lines around the circumference of the end. Hahn (1977:342) and Wissler (1924) have also linked smooth cut surfaces on antler to the action of an iron saw blade.

Marks created by a knife blade tend to be narrow and vee-shaped in cross-section (see also Walker and Long 1977).

Binford (1981:105) also described cuts made by a metal knife blade:

> Most of the cut marks made on bones with metal tools are almost hairline in size. They often appear to have been cut into the bone from the side, or obliquely, leaving an overlapping small "shelf" of bone that remains in place.

While Binford's description refers to butcher marks on bone, the general morphology resembles that of some incisions on on antler tools from the study sites (Plate 9).

The action of a knife blade is also different from that made by a saw, and may be used in a different fashion. For example, on Banks Island specimens fine cut marks were observed around the edges of blade slots, openings in shaft straighteners, on lashing surfaces of handles and in other places where surface or finishing modification was the goal. In these cases, the cut marks remaining on the piece may result from attempts to cut or whittle away small amounts of antler; alternatively, they may result from blade slippage.

Drilling

Drilled perforations exhibit regular circular edges. They are produced by rotary motion of a drill bit (Newcomer 1977:298). The Copper Inuit used a bow drill with metal bits (Jenness 1946).

Conclusion

The experiments presented here were designed to provide insights into possible technological procedures and their

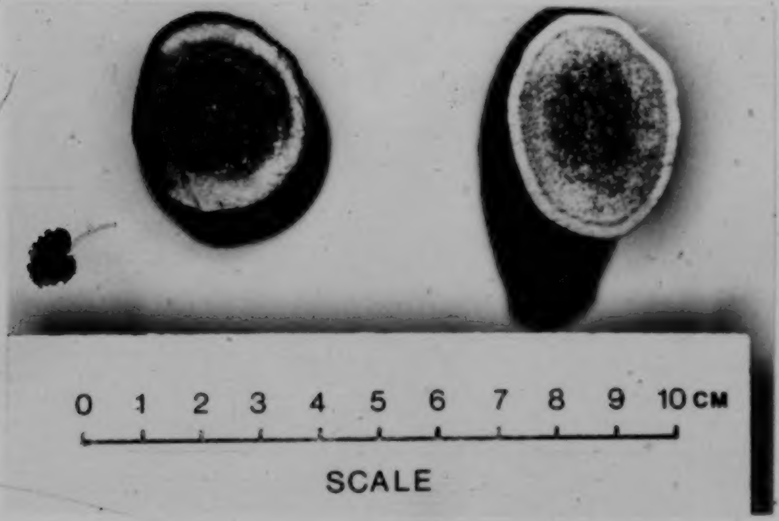
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Plate 8. Comparison of Sawn Sections:
archaeological example (left),
by author (right).

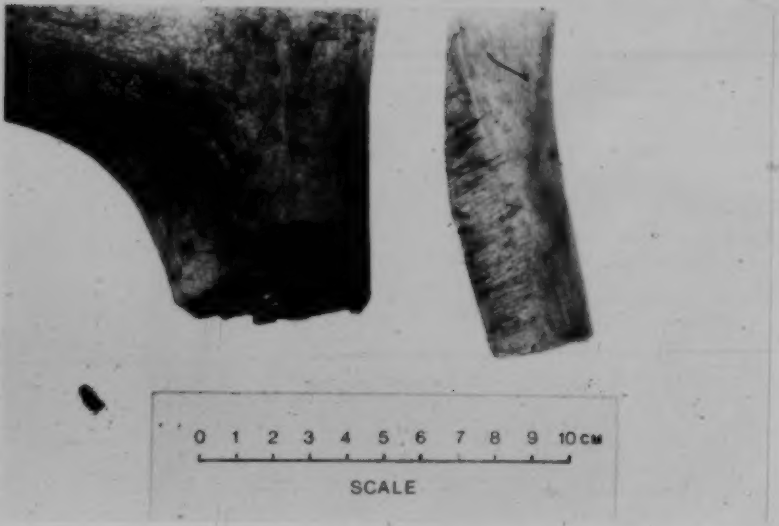
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Plate 9. Archaeological Sections Cut with
a Knife Blade.

identifying morphological features. The results cannot be taken as proofs, however, certain conclusions may be made:

1. Tools useful for working antler include burins, whittling knives, adzes and drills.
2. Both copper and iron or steel tools were successfully used experimentally to modify soaked antler. Little difference was observed in raw material performance or the resulting morphological features. The working hypothesis must now be that both metals were used in manufacturing antler artifacts.
3. In all cases except drilling, the experiments demonstrated that dry antler was difficult, and in some cases, impossible to work with metal tools.

In Chapter Four, analysis of the archaeological collection is presented. The results from the experiments will be used to make some inferences about features present on the archaeological specimens. Initially, a model of antler reduction for technological analysis and classification is presented.

IV. A TECHNOLOGICAL ANALYSIS OF COPPER INUIT ANTLER ARTIFACTS

Introduction

The goal of a technological analysis is, "...to determine the procedures used to manufacture implements through the examination of both the implements and the manufacturing debitage" (Sheets 1975:372-73). Toward that end, an antler reduction model is developed and discussed here. The model was designed to describe the sequence of processes employed in creating a finished product from antler raw material. It is, therefore, an aid in classifying specimens into stages of manufacture. The model is then applied to analysis of the archaeological samples from several Banks Island Copper Inuit sites.

A. An Antler Reduction Model

Studies of bone technology have often relied on lithic analogies for understanding the reduction/production sequence (Blaylock 1980; Corbin 1975). This may be because, like flint knapping, bone technology is a reductive process (for example, Deetz 1967). Raw material is reduced in size and shape to create the desired finished product. Unlike flint knapping, however, the finished product may retain few clues to the techniques used to produce it (e.g. flake scars) because such modifications may be obliterated during final surface treatment. In this case, by-product material may be more useful for inferring general manufacturing processes, although it may not be linked to a particular finished artifact under consideration. Debitage was examined here in order to make inferences about modification techniques, since different kinds of by-product material are variably produced, depending on the modification processes used.

Corbin (1975:86) has developed a model for reduction of caribou antler and applied it to a Nunamiut Eskimo site from Alaska. Corbin's model includes five stages: 1) section, 2) core, 3) blank, 4) preform and 5) final product. The model developed here (Figure 3) is adapted from Corbin's. It includes six categories.

1. Debitage (see below) is the by-product from any of the reduction stages.
2. A section (Plate 10) is defined here as any piece reduced in length, without any surface modification.
3. A blank (Plate 11) is modified on both ends and on at least one other surface; it has the potential to be further reduced to produce any of several, individual products.
4. A core remnant (Plate 12) is a piece from which a blank or blanks have been removed. This may be either a beam section or palmate piece.
5. A preform (Plate 13) is a piece still further reduced. It has the morphological potential to produce only one finished implement type, and which can therefore be readily distinguished. It is intended to be further

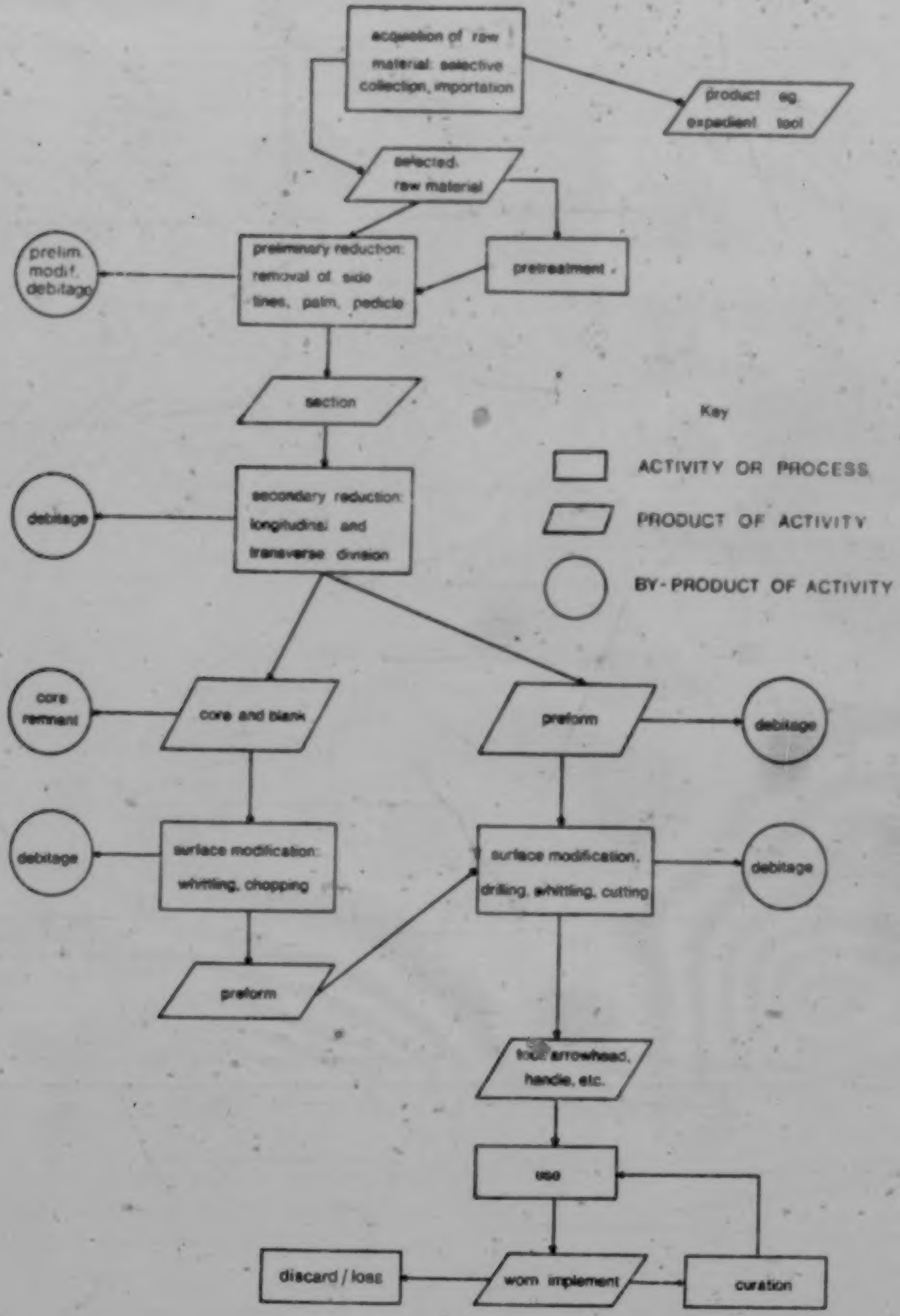
acquisition of raw material: selective collection, importation
product eg. expedient tool
selected raw material
preliminary reduction: removal of side tines, palm, pedicle
pretreatment
prelim. modif. debitage
section
Key
ACTIVITY OR PROCESS
PRODUCT OF ACTIVITY
BY-PRODUCT OF ACTIVITY
secondary reduction: longitudinal and transverse division
debitage
core and blank
core remnant
preform
debitage
surface modification: whittling, chopping
debitage
surface modification, drilling, whittling, cutting
debitage
preform
tool: arrowhead, handle, etc.
use
worn implement
discard / loss
curation

Figure 3. Process Model of Antler Reduction.

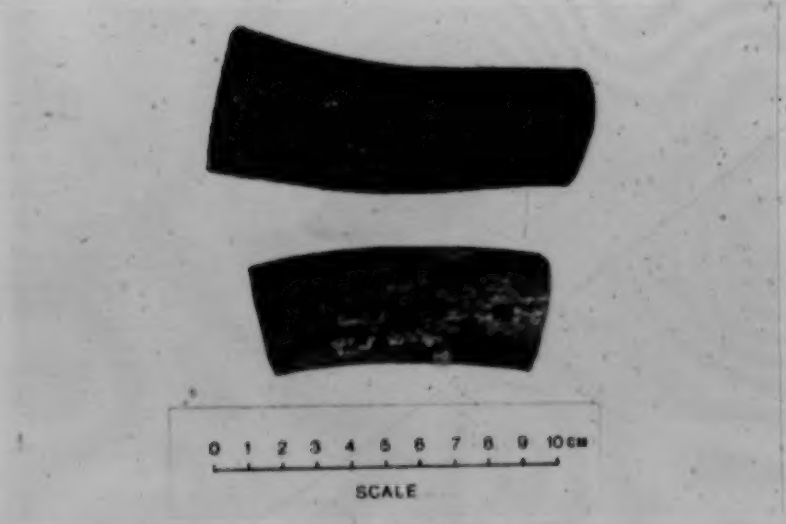
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Plate 10. Section Stage of Manufacture.

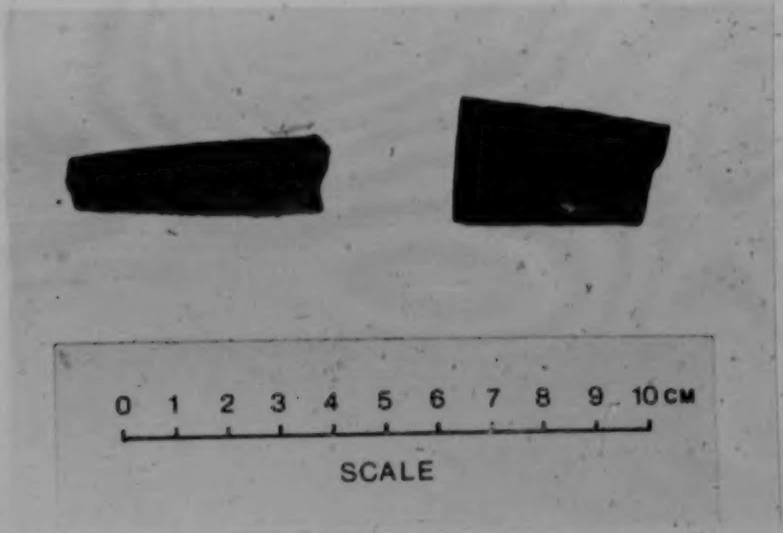
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Plate 11. Blank Stage of Manufacture.

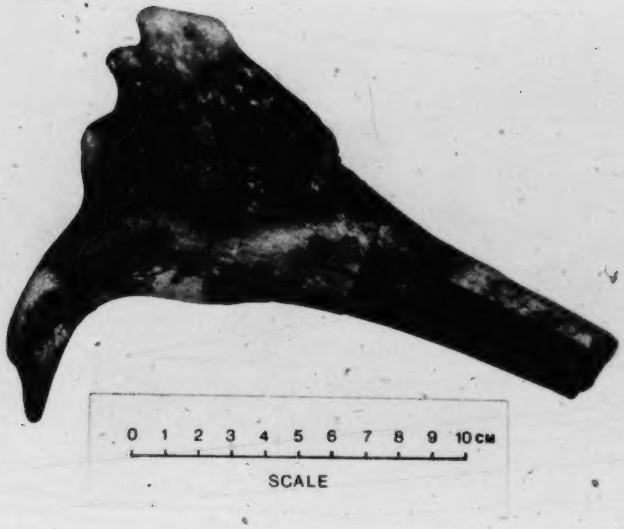
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Plate 12. Core Remnant Stage of Manufacture.

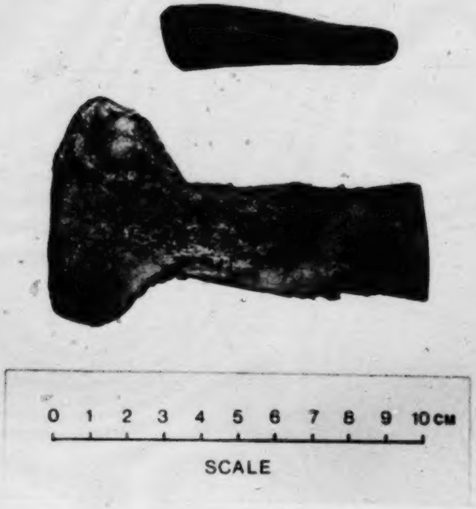
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Plate 13. Preform Stage of Manufacture.

modified.

6. A product (Plate 14) is any finished artifact of recognizable type; it is not intended for further modification.

Throughout the reduction sequence debitage is produced. Two sub-classes were distinguished: preliminary modification debitage and all other by-product material. The distinction between preliminary modification debitage and all other debitage was considered important for making inferences about modification techniques. Preliminary reduction debitage (Plate 15 A) includes material such as side tines and pedicle removed in the initial stage of reduction. The goal of this activity is to extract usable beam and/or palm sections from complete antlers. No further modification occurs to such pieces, and they constitute the single largest category of material recovered from the study sites.

The second sub-category (Plate 15 B) includes all other by-product material which can be produced at any point during tool manufacture. This category includes splinters and shavings resulting from longitudinal and, more frequently, transverse and surface reduction processes such as chopping and whittling. Therefore, it may be indicative of secondary and final modification stages. This class of debitage may also be used to locate activity areas within sites, where finished artifacts were produced or maintained.

The reduction sequence is divided into a series of stages or categories as a means for classifying individual

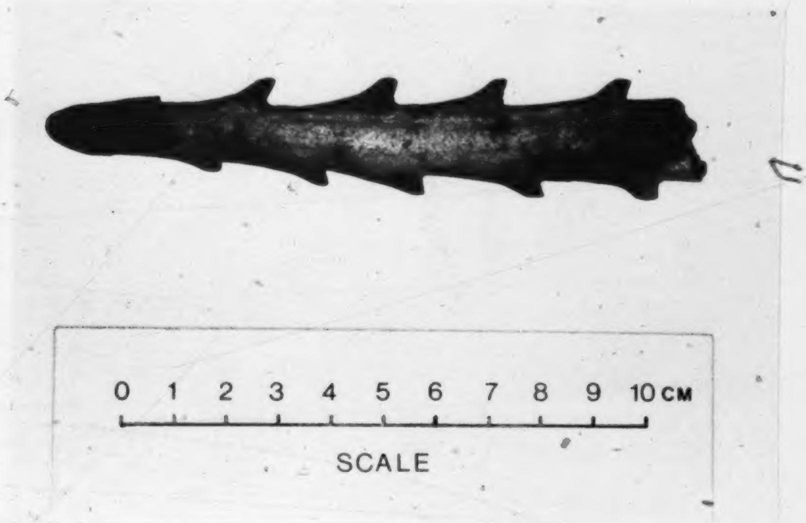
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Plate 14. Product Stage of Manufacture.

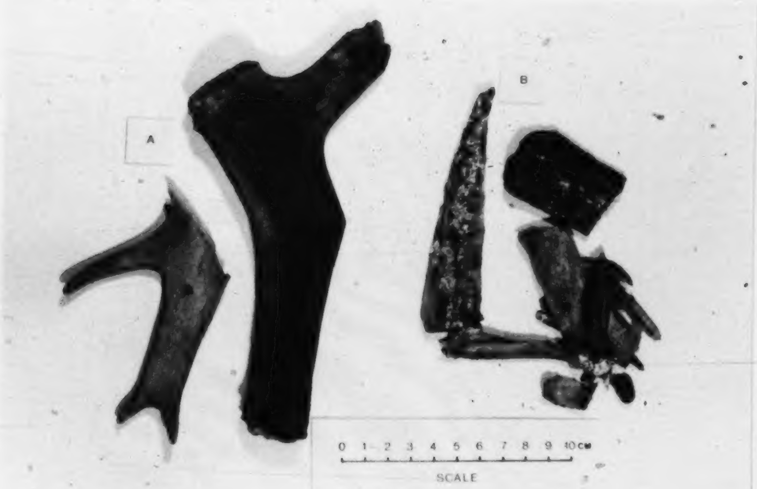
A
B
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Plate 15. Debitage Stage of Manufacture.
A. preliminary modification debitage
B. by-product debitage

artifacts for comparison. The manufacturing process is, however, conceived of as linear and interdependent: "There is a potential operation of a "feedback" relationship between steps in the manufacturing process as changes in output requirements in one step may necessitate changes in earlier steps" (Collins 1975:17).

B. Discussion of the Reduction Model

Acquisition of Raw Material

Here, the raw material is caribou antler. It was suggested in Chapter Three that shed antler was collected and used as a raw material. Experimental results indicated that dry, shed antler is difficult and, in some cases, impossible to work. If so, then pretreatment was probably conducted prior to modification. Fresh antler was probably also used when available. Jacobi (1978:318) has indicated that red deer antler is most compact and therefore best suited for tool-making in the fall, prior to shedding and after growth is completed. Caribou antler may also be best for tools in the period following cessation of growth, coincident with the fall hunting period.

Binford (1979:259) suggests that procurement of raw material is embedded within basic subsistence schedules; that is, it occurs in the process of food acquisition. The Copper Inuit hunted caribou in late summer-early fall, when hides, meat, and fat were in prime condition. Adult male antler may also be best for tool manufacture at that time, and would be acquired during the hunt for meat and skins. Then too, in late fall/early winter a great deal of activity related to clothing and equipment manufacture and repair occurred, in anticipation of the winter sealing season. Antler may have been specifically acquired seasonally to meet the needs of toolmaking.

At other times, shed antler was probably opportunistically collected in and around habitation areas. The high frequency of primary modification debitage at all sites suggests that antler was acquired during foraging activities, returned to the site, and processed, as needed. Debitage, consisting of tines, palmate sections, and pedicles were then discarded near the habitation area.

Primary Modification

Depending on the kind of tool being manufactured, primary modification includes initial processes to remove side tines, palm and pedicle by transverse sectioning from the main beam area. Any or all of the pieces thus produced may be further modified to create tools, discarded, or used as finished products (for example, simple tools or "expedient tools"). The size, shape and condition of the selected raw material are probably important factors in determining how selected antler may be used, as is, of course, the need of the craftsperson at the moment. Sections, cores, debitage and/or finished artifacts are produced from primary modification processes.

Secondary Modification: Cores and Blanks

Once sections have been obtained, blanks may be removed from the core material by longitudinal sectioning. This process includes the groove and splinter technique for dividing beam pieces, or removal of flat palmate pieces by sawing or cutting. The core remnant may then be discarded or further modified.

Secondary Modification: Sections

An alternative strategy to obtaining blanks from core material is modification of sections directly to produce final products. Then, further reduction techniques may be surface alterations to shape preforms or finished artifacts. The resulting debitage includes splinters and shavings.

Blank to Preform Modification

Once obtained, blanks may be modified to create preforms. Preforms possess morphological features resembling finished artifacts. This stage may be accomplished by shaping the blank transversly or longitudinally. Processes include chopping, whittling and cutting.

Creation of Product

The product is created by final modifications to preforms. These may include whittling and scraping the surface to a desired shape, drilling holes and, frequently, manufacture of a composite tool by the addition of another material (e.g. a metal blade). Finished artifacts may retain few signs of the earlier stages of manufacture, especially if use wear is produced.

Other Factors: Curation, Discard, Loss

Other important factors to consider are "curation", discard and loss. Curation is defined as the maintenance and recycling of worn or broken implements (Schiffer 1972:158). Worn tools may require additional work to maintain their usefulness. Broken artifacts may be mended. Then, for example, more drilled holes are often added to lash or rivet together the damaged piece. Alternatively, broken artifacts can be modified into other usable forms (refurbished), thus being recycled back into the material culture, discarded, or lost.

While not indicated in Figure 3, it is recognized that discard may occur at any point in the production process, since all stage of manufacture are represented in the archaeological sample. In this sense, "discard" is used to refer to the movement of a piece into the archaeological record, without implying intentional disposal. Intentional disposal may occur. For example broken or worn tools may be disposed of, and that activity is represented by the "discard/loss" category in Figure 3.

C. Application of the Reduction Model to the Archaeological Sample

Methods

A reduction model has been presented as a mechanism for organization and classification of manufacturing stages. Here, it will be applied to an archaeological collection from Banks Island. Methods employed in the collection and analysis of the archaeological sample are also described.

Description of the Study Sites

Material from a number of Copper Inuit archaeological sites on Banks Island was used in this study. The sites include those studied by the author in 1981 and 1982, and several others surveyed by Hickey in 1977, 1978, 1980, 1981, and 1982. The focus of the analysis was on material from three sites. These are the Kuptana (PjRa-18), Nasogaluak (PgPw-3) and Haogak (PhPo-3) sites (Figure 4). During investigations by Hickey and field crews of which the author was a member, these sites were intensively mapped. Artifactual material was collected and limited excavation was undertaken. Other sites were located on surveys conducted by Hickey when artifacts were surface collected. The three major sites were selected for research by Hickey (1982) based on their potential for providing data relevant to his research project. The information presented here is based on written reports by Hickey (1978, 1981, 1982).

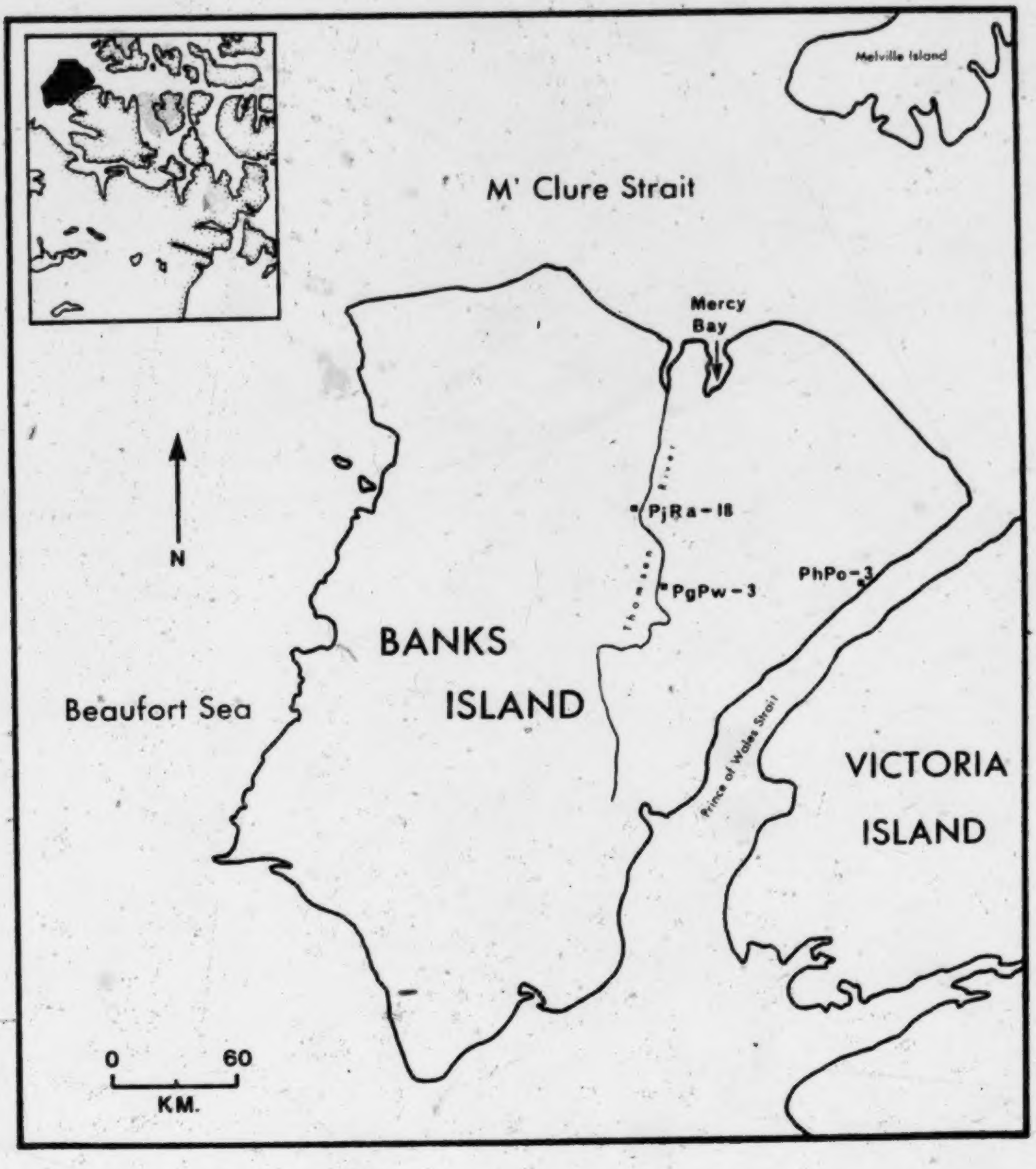

Melville Island
M' Clure Strait
Mercy Bay
PjRa-18
PgPw-3
PhPo-3
Thomsen River
N
BANKS ISLAND
Beaufort Sea
VICTORIA ISLAND
Prince of Wales Strait
0 60
KM.

Figure 4. Map of Banks Island with Study Sites.

The Kuptana Site

This site is one of the two largest on Banks Island resulting from the nineteenth century Copper Inuit occupation (Hickey 1981:10). It contains numerous tentrings and pavement structures, artifacts, faunal remains and non-native material (probably derived from the Mercy Bay cache). The site area is estimated at between 17,000 and 20,000 m^2, of which 60% has been surface mapped. Over 33,000 faunal, structural and artifactual items have been identified and computer stored for analysis. Two main activity or habitation areas have been delimited; one area at the grid northwest end of the site contains between 30 and 40 tentrings (both complete and cannibalized for later structures), of which 17 were excavated and sketch mapped in 1980 and 1982. A second occupation area is located at the southwest end. Two areas of vault caches are situated at the extreme northeast and southeast ends of the site. These contain 50 and 75 caches respectively (Hickey 1981:6). Five hundred and twelve antler artifacts from the Kuptana site were used in this study.

The Nasogaluak Site

The second site from which artifactual material was collected is situated on a high bluff overlooking the Thompsen River directly below. The site contains numerous heavy vault caches, a few tentrings and pavement areas (Hickey 1982:28). The total site area is estimated at 20,000 m², but the main occupation area is concentrated along the western site edge parallel to the river. The total area mapped and photographed is 1880 m². Musk ox bones constitute the majority of faunal remains. Fifty pieces of worked antler were mapped and collected by the author

The Haogak Site

This site is located 3 km inland from Prince of Wales Strait. It is on the second terrace above a medium-sized, unnamed river. The site area is clustered along the edge of the terrace and covers approximately 2600 m², of which 87% has been mapped. This site also contains a predominance of musk ox remains, with some birds and small mammals. Tentrings, cache and stone row structures were present. Sixty five antler artifacts were collected from the site.

Other Sites

Material from several other sites was also examined. In most cases, these sites were not visited by the author. Most material was surface collected and the site areas mapped by Hickey (1978, 1981, 1982). Information on site designations and artifacts is provided in Appendix 2.

Collection of Study Sample

Artifacts were collected from each of the three study sites by reference to a standardized two-axis grid system. The sites were gridded in 2m squares, designated by the northwest corner orientation points. Most antler artifacts occurred on the surface; they were mapped and located on a map sheet as to exact provenience within the square. Artifacts found during excavations of tentrings and other structural features were labelled by square and also located on sketch maps of the associated structural feature.

Site Sample

Site sample collection procedures were neither complete nor random. Artifacts were collected from each 2m square. Marginal site areas were not sampled in most cases, since they were neither given square designations nor mapped. The sample also reflects different site sizes and richness; 81.7% of the sample is from the Kuptana Site. With this caveat in mind, however, it should be pointed out that the sample represents an estimated minimum 50% of each site, a larger size sample than is possible at many sites, given the usual necessity to excavate to obtain any archaeological material.

Artifact Curation and Description Procedures

Permanent catalog numbers were affixed to each specimen, based on a sequential numbering system. Technology description proceeded in a standardized manner. Artifact catalog number, provenience information, shape measurements, anatomical part and taphonomic factors affecting the piece are provided in Appendix 1. Each artifact was oriented and described in the following way:

1. All specimens were oriented with their long axis perpendicular to the recorder. Choice of ventral and dorsal sides was arbitrary.
2. Maximum length, width and thickness measurements were taken. These data were recorded in order to test the importance of shape critera in material selection and utilization.
3. Anatomical part from which the material was obtained was recorded, where it was possible to determine this. Categories used were main beam, pedicle, brow tine, bez tine, main beam palm and tine (see Figure 2, page 38).
4. Taphonomic processes were also noted. A ranking system was created to record this category: (1) mild weathering and minimal lichen growth, (2) moderate weathering, splitting and lichen growth, (3) severe weathering, exfoliation and lichen growth, (4) animal chewing on tine tips, (5) animal chewing on other parts of the piece and (6) broken.
5. Technological attributes were then recorded. Pre-defined categories of technological modifications were employed. All attributes identified for each specimen were recorded, and in some cases, combinations of attribute states were used to describe an inferred process. For example, one core remnant could possess the attribute states (1) Groove Full Length, and (4) Grooved and Split (see below for descriptions of attribute states).

6. Stage of manufacture of the piece was designated, based on the definitions presented above.
7. Technological attributes and stage of manufacture designation were coded using a standardized form created for that purpose. These data were coded as either present or absent. Site number, artifact number, stage of manufacture and presence/absence of a technological attribute were then computer stored for statistical manipulation using the University of Alberta Amdahl 470V/7 computer system.

Definition of Attributes

Initially, a sample of the artifact assemblage was examined to determine the range of technological processes represented in it. The sample consisted of artifacts collected from the Kuptana Site in 1980. A working list of several attributes was created. Attribute state definitions were based on presence of possibly distinctive morphological features. Inferences were then made concerning the process responsible for the observed morphology.

The literature concerning bone technology was next consulted for examples of techniques suggested or documented by other researchers (for example, Blaylock 1980; Bonnichsen and Will 1980; Breuil 1939; Clark and Thompson 1953; Corbin 1975; Hahn 1977; Newcomer 1974, 1977; Semenov 1964; Will 1981). In some cases, the modification procedures described were not applicable to this study. These cases include differences in tools used to work the raw material (stone burins and knives, undocumented for nineteenth century Copper Inuit), the "sophistication" of the technology at hand (Breuil's (1939) study of *Homo erectus* bone technology at Choukoutien), or techniques not observed in the archaeological sample (flaking of bone as discussed by Bonnichsen (1979)).

With these two investigations as background, a list of 29 attribute states was defined. Four attribute states describe grooving methods, nine are related to sawing and cutting techniques, four describe whittling and scraping procedures, three are for chopping, and three are for drilling. A miscellaneous category of eight attributes covers techniques attributable to more than one process.

The attribute states are defined and discussed here. In most cases, photographic plates illustrating archaeological examples and frequency tables of the occurrence of each attribute by stage of manufacture accompany the text (Tables 5-10).

D. Technological Attributes

Grooving

1. Groove full length. Plate: 16

In this technique, the groove extends the full length of the long axis of the item. This procedure was used to remove blanks from core material. Groove marks may appear on both ventral and dorsal faces of core

Table 5. All Debitage: Attribute Frequencies by Site.

Attribute	PjRa-18		PgPw-3		PhPo-3		Total	
	N	%	N	%	N	%	N	%
Grooving								
1. grooved full length	9	1.5	0	0	2	3.0	11	1.5
2. partial groove	6	1.0	0	0	2	3.0	8	1.1
3. grooved and split	28	4.8	4	6.0	2	3.0	34	4.7
4. grooved and cut	16	2.7	0	0	1	1.5	17	2.4
Sawing/Cutting								
1. cut on one end	111	19.0	15	22.7	12	17.9	138	19.2
2. cut on two ends	9	1.5	4	6.0	1	1.5	14	1.9
3. ventro-dorsal angle cut	42	7.2	3	4.5	4	6.0	49	6.8
4. one side angle cut	5	0.8	1	1.5	0	0	6	0.8
5. two side angle cut	9	1.5	3	4.5	1	1.5	13	1.8
6. cut on lateral edge	19	3.2	1	1.5	4	6.0	24	3.3
7. cut on face	2	0.3	1	1.5	2	3.0	5	0.7
8. perpendicular cut	15	2.6	0	0	1	1.5	16	2.2
9. cut all around	23	3.9	1	1.5	0	0	24	3.3
Whittling/Scraping								
1. ventral face whittled	17	2.9	2	3.0	0	0	19	2.6
2. dorsal face whittled	15	2.6	1	1.5	0	0	16	2.2
3. lateral edges scraped	6	1.0	0	0	0	0	6	0.8
4. faceted surface	4	0.7	0	0	0	0	4	0.5
Chopping								
1. angle chop on end	24	4.1	1	1.5	4	6.0	29	4.0
2. lateral edges chopped	2	0.3	0	0	0	0	2	0.3
3. notches	4	0.7	0	0	0	0	4	0.5

Table 5. All Debitage: Attribute Frequencies by Site (cont.)

Attribute	PjRa-18		PgPw-3		PhPo-3		Total	
	N	%	N	%	N	%	N	%
Drilling								
1. one hole drilled	1	0.2	0	0	0	0	1	0.1
2. GT one hole drilled	3	0.3	0	0	0	0	3	0.4
3. broken along drilled holes	1	0.2	0	0	0	0	1	0.1
Other Attributes								
1. snapped	88	15.0	9	13.6	9	13.4	106	14.8
2. cut marks	29	5.0	7	10.6	4	6.0	40	5.6
3. vee-shaped cut	6	1.0	0	0	0	0	6	0.8
4. tines removed	54	9.2	9	13.6	3	4.5	66	9.2
5. section removed	3	0.3	0	0	0	0	3	0.4
6. slotted blade end	0	0	0	0	0	0	0	0
7. scarfed end	0	0	0	0	0	0	0	0
8. broken	34	5.8	4	6.0	15	22.4	53	7.4
Totals	585	81.8	66	9.2	167	9.4	718	100

Table 8. Sections: Attribute Frequencies by Site.

Attribute	PjRa-18		PgPw-3		PhPo-3		Total	
	N	%	N	%	N	%	N	%
Grooving								
1. grooved full length	1	1.0	0	0	0	0	1	0.8
2. partial groove	2	2.0	0	0	0	0	2	1.7
3. grooved and split	0	0	0	0	0	0	0	0
4. grooved and cut	0	0	0	0	0	0	0	0
Sawing/Cutting								
1. cut on one end	11	10.8	0	0	0	0	11	9.4
2. cut on two ends	14	13.7	3	42.9	2	25.0	19	16.2
3. ventro-dorsal angle cut	5	4.9	0	0	0	0	5	4.3
4. one side angle cut	2	2.0	0	0	1	12.5	3	2.6
5. two side angle cut	4	3.9	0	0	1	12.5	5	4.3
6. cut on lateral edges	3	2.9	0	0	0	0	3	2.6
7. cut on face	0	0	0	0	0	0	0	0
8. perpendicular cut	7	6.9	0	0	0	0	7	6.0
9. cut all around	10	9.8	0	0	0	0	10	8.5
Whittling/Scraping								
1. ventral face whittled	0	0	1	14.3	0	0	1	0.8
2. dorsal face whittled	0	0	0	0	0	0	0	0
3. lateral edges scraped	2	2.0	0	0	0	0	2	1.7
4. faceted surface	0	0	0	0	0	0	0	0
Chopping								
1. angle chop on end	1	1.0	0	0	0	0	1	0.8
2. lateral edges chopped	1	1.0	0	0	0	0	1	0.8
3. notches	1	1.0	0	0	0	0	1	0.8

Table 6. Sections: Attribute Frequencies by Site (cont.)

Attribute	PjRa-18		PgPw-3		PhPo-3		Total	
	N	%	N	%	N	%	N	%
Drilling								
1. one hole drilled	0	0	0	0	0	0	0	0
2. GT one hole drilled	0	0	0	0	0	0	0	0
3. broken along drilled holes	1	1.0	0	0	0	0	1	0.8
Other Attributes								
1. snapped	16	15.7	1	14.3	1	12.5	18	15.4
2. cut marks	7	6.9	0	0	1	12.5	8	6.8
3. vee-shaped cut	0	0	0	0	0	0	0	0
4. tines removed	5	4.9	1	14.3	0	0	6	5.1
5. section removed	0	0	0	0	0	0	0	0
6. slotted blade end	0	0	0	0	0	0	0	0
7. scarfed end	1	1.0	0	0	1	12.5	2	1.7
8. broken	8	7.8	1	14.3	1	12.5	10	8.5
Totals	102	87.2	7	6.0	8	6.8	117	100

Table 7. Blanks: Attribute Frequencies by Site.

Attribute	**PjRa-18**		**PgPw-3**		**PhPo-3**		**Total**	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Grooving								
1. grooved full length	5	6.6	1	6.6	0	0	6	5.8
2. partial groove	0	0	0	0	0	0	0	0
3. grooved and split	6	7.9	3	20.0	3	23.1	12	11.5
4. grooved and cut	2	2.6	0	0	1	7.7	3	2.9
Sawing/Cutting								
1. cut on one end	8	10.5	2	13.3	1	7.7	11	10.6
2. cut on two ends	9	11.8	2	13.3	2	15.4	13	12.5
3. ventro-dorsal angle cut	2	2.6	0	0	0	0	2	1.9
4. one side angle cut	1	1.3	0	0	0	0	1	1.0
5. two side angle cut	1	1.3	0	0	1	7.7	2	1.9
6. cut on lateral edges	3	3.9	0	0	0	0	3	2.9
7. cut on face	2	2.6	0	0	1	7.7	3	2.9
8. perpendicular cut	2	2.6	0	0	0	0	2	1.9
9. cut all around	2	2.6	0	0	0	0	2	1.9
Whittling/Scraping								
1. ventral face whittled	1	1.3	2	13.3	1	7.7	4	3.8
2. dorsal face whittled	2	2.6	2	13.3	1	7.7	5	4.8
3. lateral edges scraped	2	2.6	0	0	0	0	2	1.9
4. faceted surface	1	1.3	0	0	0	0	1	1.0
Chopping								
1. angle chop on end	2	2.6	0	0	0	0	2	1.9
2. lateral edges chopped	4	5.3	0	0	0	0	4	3.8
3. notches	1	1.3	0	0	0	0	1	1.0

Table 7. Blanks: Attribute Frequencies by Site (cont.)

Attribute	PjRa-18		PgPw-3		PhPo-3		Total	
	N	%	N	%	N	%	N	%
Drilling								
1. one hole drilled	0	0	0	0	1	7.7	1	1.0
2. GT one hole drilled	1	1.3	0	0	0	0	1	1.0
3. broken along drilled holes	0	0	0	0	0	0	0	0
Other Attributes								
1. snapped	8	10.5	1	6.6	0	0	9	8.6
2. cut marks	2	2.6	0	0	0	0	2	1.9
3. vee-shaped cut	1	1.3	0	0	0	0	1	1.0
4. tines removed	1	1.3	0	0	1	7.7	2	1.9
5. section removed	1	1.3	0	0	0	0	1	1.0
6. slotted blade end	1	1.3	0	0	0	0	1	1.0
7. scarfed end	1	1.3	0	0	0	0	1	1.0
8. broken	4	5.3	2	13.3	0	0	6	5.8
Totals	76	73.1	15	14.4	13	12.5	104	100

remnants, or on the splinter removed. Blanks were then either wedged or cut out. In the former case, the cancellous tissue surface appears uneven, and impact scars may be observable where a wedge-like tool was driven into the grooves and splinters forced out (here, the attribute Grooved and Split was also recorded for the specimen). In the latter case, both the groove's edge and spongy tissue surface appear smooth (and Grooved and Cut was also recorded).

2. Partial groove.

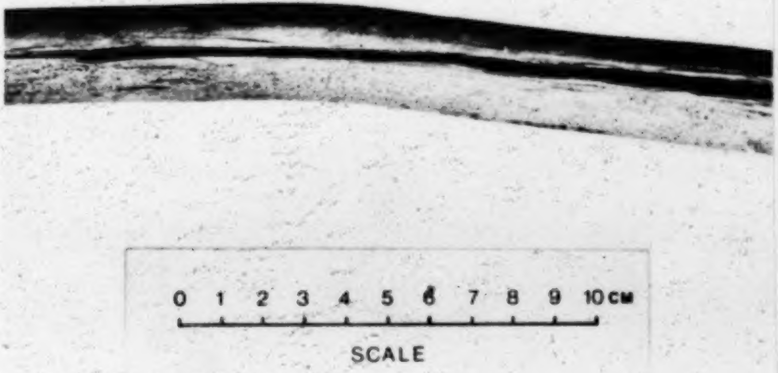
   This category includes cases where the groove does not extend the full length of the piece. Some of these cases may be "mistakes" - where a groove was started, found unsatisfactory and discontinued. In other instances, partial grooves reflect a strategy of selective removal of parts (the pedicle or palm portions, for example).

3. Grooved and split. Plate: 17

   This attribute state best describes core remnants where groove marks are observable near the ends or lateral edges of removed blanks. Core remnants categorized in this way possess ragged edges and exposed surfaces of cancellous tissue where blanks were wedged out. Blanks may also be produced by double grooving and splitting through the mid-diameter of beam sections.

4. Grooved and cut. Plate: 18

   This attribute state describes pieces resulting from longitudinal division and possessing smooth cut edges.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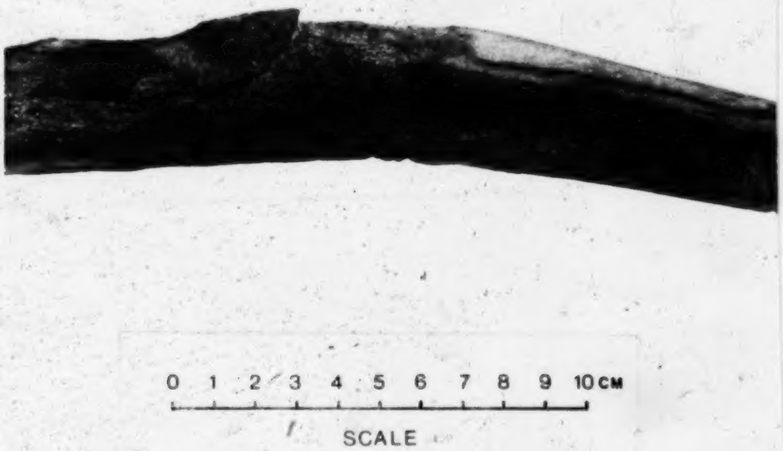
SCALE

Plate 16. Grooved Full Length.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SCALE

Plate 17. Grooved and Split.

It is suggested that the raw material was first grooved and then the grooves were used to guide the movement of a sharp blade (saw or knife) to cut through the less dense spongy bone in the center of the antler section.

Sawing or Cutting

Nine attribute states were defined for sawing or cutting processes. The term 'cut' relates to the incision, but does not assume a cutting process necessarily. The first two attributes are:

1. One End Cut.
2. Two Ends Cut.

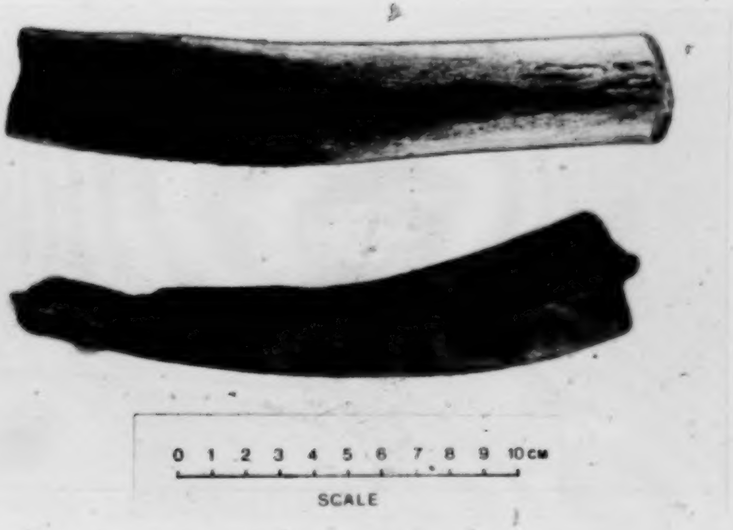
These attribute states refer to the location of the modification. End modifications are a preliminary reduction technique used to sever unwanted pieces from sections desired for further processing. The remaining 14 categories relate to the processes employed to modify raw material using cutting and sawing strategies.

3. Ventro-dorsal angle cut. Plate: 19

The section is cut on an angle through both the ventral and dorsal faces of the artifact. The technique severs the compact tissue. The less resistant cancellous tissue may then be snapped, leaving a ragged end.

4. One-side angle cut.

One lateral edge of the specimen is cut or sawn on an oblique angle. The raw material is severed by this process. This attribute state was found on one or both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SCALE

Plate 18. Grooved and Cut.

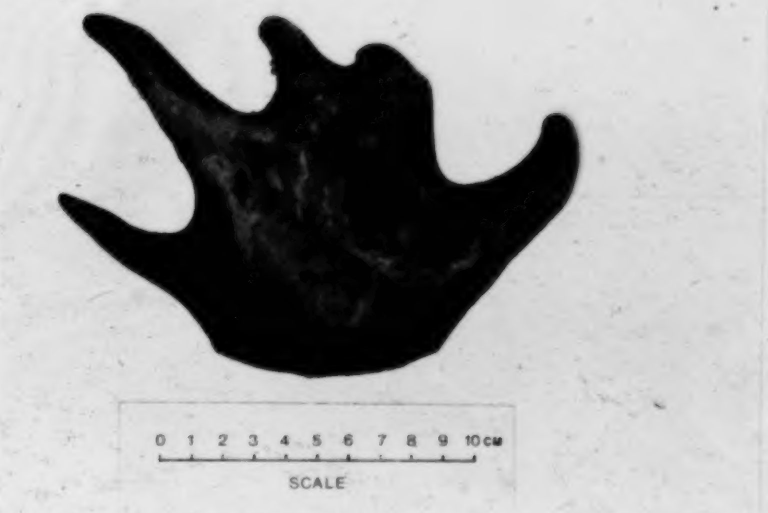

0 1 2 3 4 5 6 7 8 9 10cm
SCALE

Plate 19. Ventro-dorsal Angle Cut.

ends of specimens.

5. Two-side angle cut.

The specimen is cut on an oblique angle through both lateral edges toward the midline. A vee-shaped cut end results.

6. Cut on lateral edge.

The lateral edges are sawn or cut to thin the material transversely. Sawing tends to leave smooth cut edges, as opposed to cutting and whittling which leave nicks and chattermarks (see below).

7. Cut on face.

Either one or both faces are sawn or cut. This attribute state describes surface modifications made on preforms to create finished products including surface thinning and creation of specific modifications (lashing marks, shoulders and harpoon barbs).

8. Perpendicular cut.

Perpendicular cuts are cut or sawn surfaces or marks made at a 90° angle to the long axis of the piece. Perpendicular cuts are made to sever one or both ends of beam sections and thereby reduce the material longitudinally.

9. Cut all around. Plate: 20

This modification occurs on one or both ends of raw material. The technique involves cutting with a knife or other blade all around the end of a piece and severing it through the spongy bone. The resulting end is trapezoidal in cross-section.

Whittling and Scraping

It has been suggested that whittling and scraping processes were used to shape surfaces of sections, blanks and preforms to create a finished product. Four attributes states were defined for this process.

1. Ventral face whittled/scraped.
2. Dorsal face whittled/scraped.
3. Lateral edges whittled/scraped.
4. Faceted surface.

Surface scraping is evident by the presence of fine linear striations (Newcomer 1974; Semenov 1964; Experiment Two, Chapter Three; see Plate 6E, page 65, for an example). Another characteristic morphology of this process is chattermarks and nicks along uneven edges of the piece. Chattermarks are:

> ...closely spaced corrugations at right angles to the [linear] striations...The chattermarks seem to be caused by the stone tool bouncing over uneven parts of the bone surface and thus failing to maintain contact with the bone throughout its sweep (Newcomer 1974:149).

Another whittling/scraping attribute state identified is faceted surfaces. Faceting may be related to edge shaping processes in which the whittling blade is pulled across the edge of the piece and produces a beveled surface.

Chopping

Chopping may have been used for preliminary reduction processes such as severing sections in two, removing unwanted parts and reduction-shaping. Three chopping attribute states were defined.

1. Angle Chop on End   Plate: 21

Sections were severed in two by chopping through the compact bone at an angle to the long axis. Sections chopped in this manner possess notches and roughened areas circumscribing the modified end.

2. Lateral Edges Chopped.

Reduction shaping was accomplished by chopping the piece to modify it. The lateral edges bear notches (see below) where thinning was accomplished.

3. Notches.   Plate: 22

The presence of asymetrical notches on modified pieces has been tentatively correlated with chopping processes. Experimentation suggests that notches result when an adze impacts the surface at a 60°-90° angle.

Drilling

Drilled holes are a distinctive attribute, most commonly found on finished artifacts where they served a functional purpose in lashing, blade hafting or suspension.

Drilling was probably a final-stage modification in this case. Drilling attribute states recorded are:

1. One hole drilled.
2. More than one hole drilled.
3. Broken along drilled holes. Plate: 23

   In this case, holes were drilled in a series in order to split the piece. This technique for longitudinal reduction is uncommon, occurring on only two specimens.

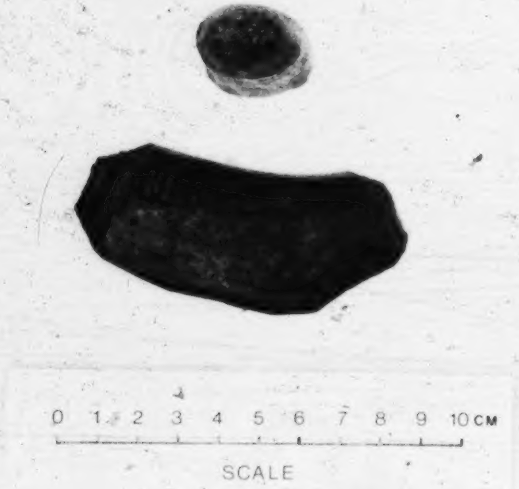
Other Attributes

1. Snapped. Plate: 24

   The technique involves breaking the raw material after an incision has been made in the hard cortex. This process characteristically results in a rough surface, lipping on one edge where the the material was incompletely severed and/or a splintered edge where the cortex breaks away.

2. Cut Marks.

   Cut marks were coded when they appeared on specimens. They may result from several activities. Numerous incisions were observed around the cut ends of some pieces, where the raw material was repeatedly incised and then snapped. Other cut marks probably represent mistakes due to blade slippage or misapplication of the cut. Two kinds of cut marks were identified from their morphology - square-bottomed and vee-shaped, as discussed above.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SCALE

Plate 20. Cut All Around.

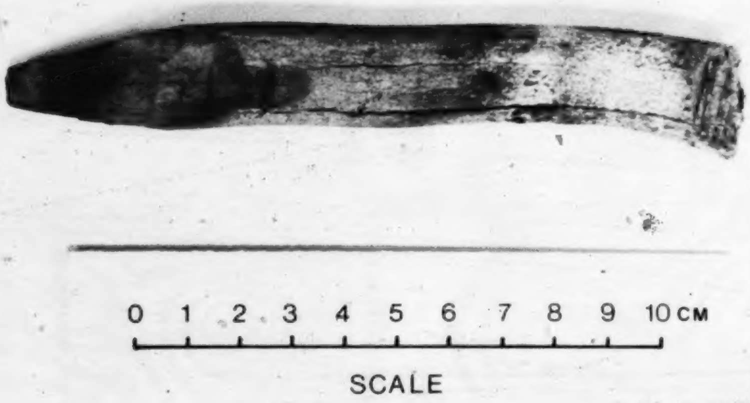

0 1 2 3 4 5 6 7 8 9 10 CM
SCALE

Plate 21. Angle Chop on End.

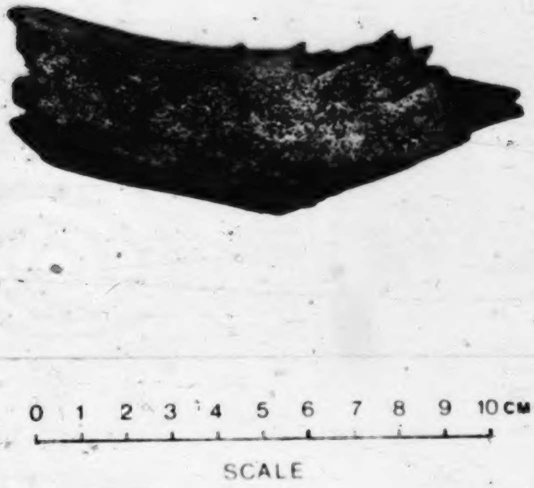

0 1 2 3 4 5 6 7 8 9 10CM
SCALE

Plate 22. Notches.

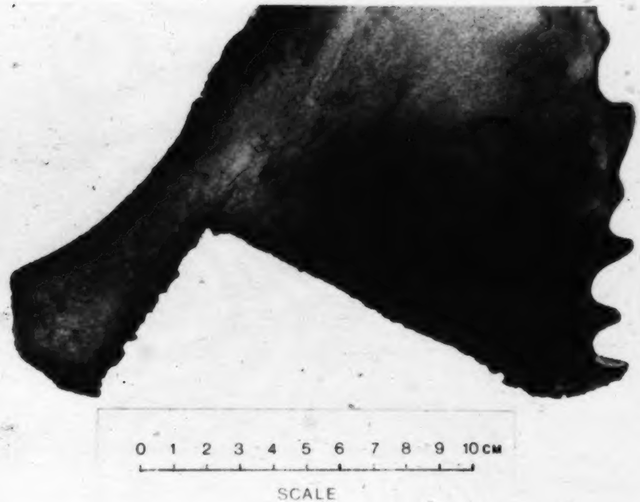

0 1 2 3 4 5 6 7 8 9 10CM
SCALE

Plate 23. Broken Along Drilled Holes.

Table 8. Core Remnants: Attribute Frequencies by Site.

Attribute	PjRa-18 N	PjRa-18 %	PgPw-3 N	PgPw-3 %	PhPo-3 N	PhPo-3 %	Total N	Total %
Grooving								
1. grooved full length	7	10.8	0	0	0	0	7	10.3
2. partial groove	3	4.6	0	0	0	0	3	4.4
3. grooved and split	13	20.0	0	0	0	0	13	19.1
4. grooved and cut	4	6.1	0	0	0	0	4	5.9
Sawing/Cutting								
1. cut on one end	4	6.1	0	0	0	0	4	5.9
2. cut on two ends	3	4.6	0	0	1	33.3	4	5.9
3. ventro-dorsal angle cut	1	1.5	0	0	0	0	1	1.5
4. one side angle cut	1	1.5	0	0	0	0	1	1.5
5. two side angle cut	1	1.5	0	0	0	0	1	1.5
6. cut on lateral edges	1	1.5	0	0	0	0	1	1.5
7. cut on face	1	1.5	0	0	1	33.3	2	1.5
8. perpendicular cut	2	3.1	0	0	0	0	2	2.9
9. cut all around	3	4.6	0	0	0	0	3	4.4
Whittling/Scraping								
1. ventral face whittled	0	0	0	0	0	0	0	0
2. dorsal face whittled	0	0	0	0	0	0	0	0
3. lateral edges scraped	1	1.5	0	0	0	0	1	1.5
4. faceted surface	0	0	0	0	0	0	0	0
Chopping								
1. angle chop on end	1	1.5	0	0	0	0	1	1.5
2. lateral edges chopped	0	0	0	0	0	0	0	0
3. notches	0	0	0	0	0	0	0	0

Table 8. Core Remnants: Attribute Frequencies by Site (cont.)

Attribute	PjRa-18		PgPw-3		PhPo-3		Total	
	N	%	N	%	N	%	N	%
Drilling								
1. one hole drilled	0	0	0	0	0	0	0	0
2. GT one hole drilled	0	0	0	0	0	0	0	0
3. broken along drilled holes	0	0	0	0	0	0	0	0
Other Attributes								
1. snapped	7	10.8	0	0	0	0	7	10.3
2. cut marks	3	3.1	0	0	1	33.3	4	5.9
3. vee-shaped cut	0	0	0	0	0	0	0	0
4. tines removed	6	9.2	0	0	0	0	6	8.8
5. section removed	0	0	0	0	0	0	0	0
6. slotted blade end	0	0	0	0	0	0	0	0
7. scarfed end	0	0	0	0	0	0	0	0
8. broken	3	4.6	0	0	0	0	3	4.4
Totals	65	95.6	0	0	3	4.4	68	100

Table 9. Preforms: Attribute Frequencies by Site.

Attribute	PjRa-18		PgPw-3		PhPo-3		Total	
	N	%	N	%	N	%	N	%
Grooving								
1. grooved full length	0	0	0	0	0	0	0	0
2. partial groove	0	0	0	0	0	0	0	0
3. grooved and split	0	0	0	0	0	0	0	0
4. grooved and cut	0	0	0	0	0	0	0	0
Sawing/Cutting								
1. cut on one end	7	12.5	2	14.3	0	0	9	9.8
2. cut on two ends	5	9.1	0	0	4	17.4	9	9.8
3. ventro-dorsal angle cut	4	7.3	1	7.1	0	0	5	5.4
4. one side angle cut	1	1.8	0	0	0	0	1	1.1
5. two side angle cut	0	0	1	7.1	1	4.3	2	2.2
6. cut on lateral edge	2	3.6	1	7.1	1	4.3	4	4.3
7. cut on face	3	5.4	1	7.1	1	4.3	5	5.4
8. perpendicular cut	3	5.4	0	0	0	0	3	3.3
9. cut all around	0	0	0	0	0	0	0	0
Whittling/Scraping								
1. ventral face whittled	6	11.0	1	7.1	3	13.0	10	10.9
2. dorsal face whittled	6	11.0	1	7.1	3	13.0	10	10.9
3. lateral edges scraped	2	3.6	1	7.1	2	8.7	5	5.4
4. faceted surface	3	5.4	0	0	3	13.0	6	6.5
Chopping								
1. angle chop on end	1	1.8	0	0	0	0	1	1.1
2. lateral edges chopped	2	3.6	0	0	0	0	2	2.2
3. notches	1	1.8	0	0	0	0	1	1.1

Table 9. Preforms: Attribute Frequencies by Site (cont.)

Attribute	PjRa-18 N	PjRa-18 %	PgPw-3 N	PgPw-3 %	PhPo-3 N	PhPo-3 %	Total N	Total %
Drilling								
1. one hole drilled	0	0	0	0	0	0	0	0
2. GT one hole drilled	0	0	1	7.1	0	0	1	1.1
3. broken along drilled holes	1	1.8	0	0	0	0	1	1.1
Other Attributes								
1. snapped	2	3.6	0	0	4	17.4	6	6.5
2. cut marks	1	1.8	1	7.1	0	0	2	2.2
3. vee-shaped cut	0	0	0	0	1	4.3	1	1.1
4. tines removed	0	0	1	7.1	0	0	1	1.1
5. section removed	0	0	0	0	0	0	0	0
6. slotted blade end	4	7.3	1	7.1	0	0	5	5.4
7. scarfed end	0	0	0	0	0	0	0	0
8. broken	1	1.8	1	7.1	0	0	2	2.2
Totals	55	59.8	14	15.2	23	25.0	92	100

Table 10: Products (Finished Artifacts): Attribute Frequencies by Site.

Attribute	**PjRa-18**		**PgPw-3**		**PhPo-3**		**Total**	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Grooving								
1. grooved full length	0	0	0	0	1	1.4	1	0.1
2. partial groove	0	0	0	0	0	0	0	0
3. grooved and split	2	0.3	0	0	0	0	2	0.3
4. grooved and cut	0	0	0	0	0	0	0	0
Sawing/Cutting								
1. cut on one end	27	4.3	1	4.2	1	1.4	29	4.0
2. cut on two ends	12	1.9	2	8.3	3	4.3	17	2.4
3. ventro-dorsal angle cut	1	0.1	1	4.2	0	0	2	0.3
4. one side angle cut	1	0.1	0	0	0	0	1	0.1
5. two side angle cut	3	0.5	0	0	1	1.4	4	0.5
6. cut on lateral edge	55	8.8	1	4.2	5	7.2	61	8.5
7. cut on face	11	1.7	5	20.8	8	11.6	24	3.3
8. perpendicular cut	8	1.3	0	0	0	0	8	1.1
9. cut all around	2	0.3	0	0	0	0	2	0.3
Whittling/Scraping								
1. ventral face whittled	102	16.3	4	16.6	11	15.9	117	16.2
2. dorsal face whittled	99	15.8	2	8.3	12	17.4	113	15.7
3. lateral edges scraped	25	25.1	1	4.2	3	4.3	29	4.0
4. faceted surface	17	2.7	0	0	5	7.2	22	3.0
Chopping								
1. angle chop on end	1	0.1	0	0	0	0	1	0.1
2. lateral edges chopped	2	0.3	0	0	0	0	2	0.3
3. notches	1	0.1	0	0	0	0	1	0.1

Table 10: Products (Finished Artifacts) Attribute Frequencies by Site (cont.)

Attribute	PjRa-18		PgPw-3		PhPo-3		Total	
	N	%	N	%	N	%	N	%
Drilling								
1. one hole drilled	24	3.8	1	4.2	3	4.3	28	3.9
2. GT one hole drilled	35	5.6	0	0	3	4.3	38	5.3
3. broken along drilled holes	3	0.5	0	0	2	2.9	5	0.7
Other Attributes								
1. snapped	5	0.8	0	0	1	1.4	6	0.8
2. cut marks	38	6.1	0	0	2	2.9	40	5.5
3. vee-shaped cut	1	0.1	0	0	0	0	1	0.1
4. tines removed	2	0.3	0	0	0	0	2	0.3
5. section removed	1	0.1	0	0	0	0	1	0.1
6. slotted blade end	33	5.3	3	12.5	7	10.1	43	6.0
7. scarfed end	46	7.3	1	4.2	1	1.4	48	6.6
8. broken	70	11.2	2	8.3	0	0	72	10.0
Totals	627	87.1	24	3.3	69	9.6	720	100

3. Vee-shaped cuts.

Cut marks with a vee-shaped cross section were differentiated based on their morphology. It was inferred that they were produced either by a narrow, sharp blade such as a knife, or by an adze chop. In the former case, the knife blade was drawn back and forth across the surface perpendicular to the long axis (see Plate 9, page 76). This process differs from whittling in which the blade is applied parallel to the long axis (see Experiment Three, Chapter Three) and the result is probably a series of numerous, short cuts paralleling one another. In the latter case, the cut marks possess a wider apex, resembling notches. Based on experimentation, it is suggested that they were created by an adze or axe used in a chopping manner (Experiment Two).

4. Tines Removed.

One category of preliminary processed debitage includes tines removed from the palm area of the beam. These pieces occur unmodified and palm pieces (core remnants) have been recovered in which the tines have been sawn, cut or broken off. The tines may have been used to fashion arrowheads, since they already possess a shape similar to the finished product (Hahn 1977).

5. Section Removed.

This attribute describes cases where a section or blank has been removed from a core remnant, using some process other than grooving. For example, in at least two cases flat sections were removed by breaking the piece along a series of drilled holes. In other cases, blanks were sawn or cut from the raw material.

6. Slotted Blade End. Plate: 25

This attribute refers to the process of creating slots or recessed areas in pieces for hafting of blades or assembling composite pieces. Depending on the finished product being produced, slots range in shape from thin rectangular cuts on knife handles to deep, circular sockets on harpoon foreshafts.

The processes used to create slots are not always apparent; however, some observations are relevant. Thin slots, as for metal blades, may have been created by a grooving and cutting technique. The slot dimensions were first outlined with a burin, and then a knife blade was used to cut the slot to the desired depth. The edges of some slots retain cut marks suggestive of this procedure. Larger square and round sockets may have been created by first drilling holes at the corners of the planned socket and then the spongy tissue was cut or gouged out. Remnants of semi-circular holes are evident at the edges of some sockets.

7. Scarfed End. Plate: 26

Scarfing refers to a technique for hafting sections spliced together (see Birket-Smith 1945:162). The piece is cut on an oblique angle through one lateral edge or

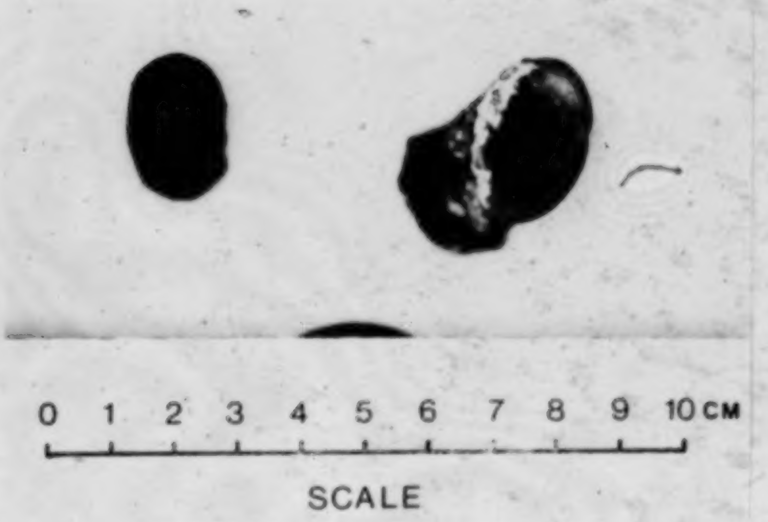

0 1 2 3 4 5 6 7 8 9 10 CM
SCALE

Plate 24. Snapped.

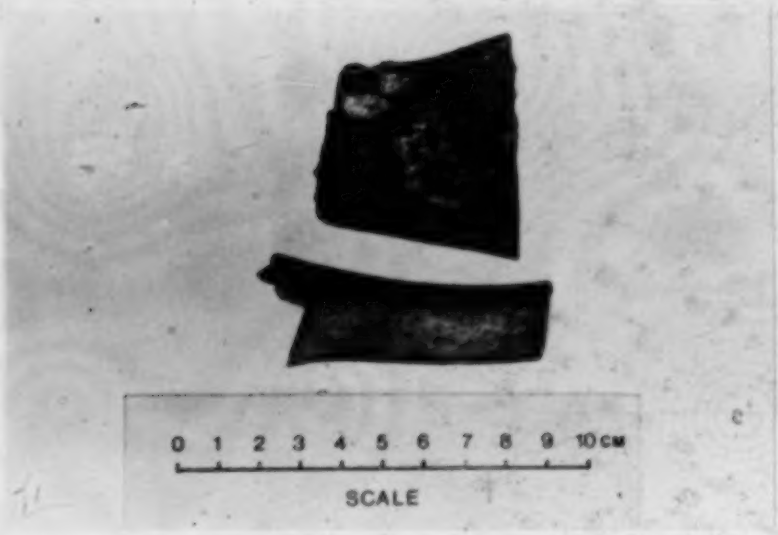

0 1 2 3 4 5 6 7 8 9 10 CM
SCALE

Plate 25. Slotted Blade End.

through one face. Lashing marks are present on the internal aspect of some finished arrowheads.

8. Broken.

Three attribute states were recorded for broken specimens: Broken on One End, Broken on Two Ends and Tine(s) Broken Off. Breakage was recorded as one possible factor related to discard, since pieces broken during manufacture may have been discarded rather than recycled. Post-depositional breaks could not be discerned however, unless they were recent enough to have weathered differentially from the rest of the piece. One hundred and eight of the total sample of 627 specimens from the three large study sites were broken on at least one end. Of that sample, 54, or 50% were broken finished artifacts.

Summary

An attempt was made to integrate three analytic units within the technological model presented here. These are stages of manufacture, manufacturing processes, and technological attributes. Archaeological specimens were classified into stages of manufacture, based on defined criteria. Manufacturing processes (grooving, cutting and sawing, whittling and scraping, chopping, and drilling) were suggested by reference to ethnographic and experimental analogy. Morphological attributes were defined to describe manufacturing processes, and were linked to them by

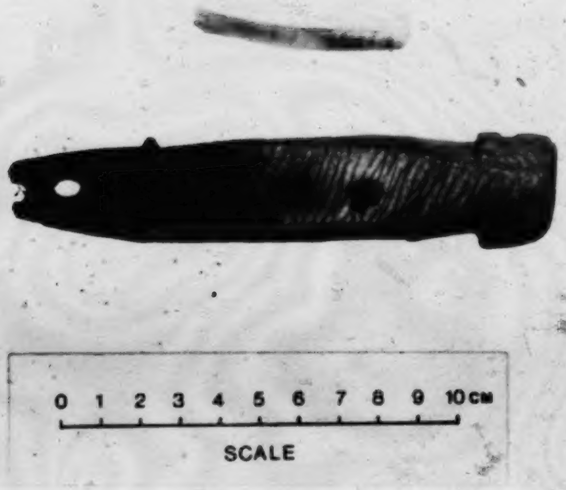

0 1 2 3 4 5 6 7 8 9 10 CM
SCALE

Plate 26. Scarfed End with Lashing Marks.

reference to other prehistoric bone industries described in the literature. The implications of the artifact analysis for an understanding of Copper Inuit antler technology will be addressed in the succeeding and final chapter.

V. INTERPRETATION AND CONCLUSION

Introduction

Results of analysis and implications of this study for an understanding of the process of antler technology are discussed. Three topics are addressed: antler use and artifact production; strategies of reduction; and intra- and intersite variability in technology. Finally, some suggestions are made for future research.

A. Antler Use and Artifact Production

In Table 11 the distribution of artifacts by stage of manufacture is presented for each of the three main study sites. The stage of manufacture designation follows criteria presented in Chapter Four. Based on the results depicted tabularly, certain conclusions may be made concerning antler use and artifact production.

The largest category of items at all three sites is debitage - 45.6% (N=286) of the sample. Two sub-categories of debitage were defined in Chapter Four. These are hypothesized to be indicative of different modification processes: primary reduction debitage; and splinters and shavings resulting from surface treatments. The frequency of occurrence of these two sub-categories at the study sites is presented in Table 12. Over 62% of the sample is preliminary modification debitage, which may be a result of sample bias -- larger material was more likely to be visible on the surface, whereas smaller pieces of debitage were more

Table 11. Distribution of Artifacts by Site and Stage of Manufacture.

Site	Debitage	Section	Blank	Core	Preform	Product	Indeterminate	Total
PjRa-18 (N)	228	31	20	15	15	148	55	512
(% Site)	44.5	6.0	3.9	2.9	2.9	28.9	10.7	
(% Total)	36.4	4.9	3.2	2.4	2.4	23.6	8.8	81.7
PgPw-3 (N)	28	4	5	0	3	7	3	50
(% Site)	56.0	8.0	10.0	0	6.0	14.0	6.0	
(% Total)	4.5	0.6	0.9	0	0.5	1.1	0.5	8.0
PhPo-3 (N)	30	4	4	2	4	19	2	65
(% Site)	46.1	6.1	6.1	3.1	6.1	29.2	3.1	
(% Total)	4.8	0.6	0.6	0.3	0.6	3.0	0.3	10.4
Totals (N)	286	39	29	17	22	174	60	627
(%)	45.6	6.2	4.6	2.7	3.5	27.7	9.6	100

frequently collected during tentring excavations (see Appendix 1 for provenience information).

One reason for the high percentage of debitage is the nature of the reduction process itself. During the creation of one artifact, a great deal of debitage and rejected material is produced. A lithic analogy may be useful here. For example, Lavine-Lischka (1976) reports a sample of 70-90% debitage from eight different lithic assemblages at sites in Arizona.

The second largest category present is finished artifacts, with 27.7% (N=174) of the sample. Artifacts broken during use may have been discarded on-site, and unbroken implements may have been left behind for future use on return, discarded or misplaced. Expedient tools were probably discarded after use, as suggested by Jenness (1946:3). "...Bone or antler wedges, [were] generally made for each occasion and immediately discarded..." Given that pre- and post-depositional breakage could not be discriminated in most cases, only tentative suggestions concerning discard behavior may be made. Thirty-one percent (N=54) of the finished artifacts were broken. In comparison, 69.5% (N=36) of the finished artifacts collected from 16 surface-collected sites were broken.

Binford (1979:269), calling on his observations of contemporary Nunamiut Eskimo hunters, states,

> Items of personal gear and household gear are apt to be both produced and maintained within residential sites, resulting in an association at such locations of debris from manufacture, repair, and final

Table 12. Debitage Sub-categories at Study Sites.

Site		Primary Modification Debitage	All Other Debitage	Total
PjRa-18	(N)	147	81	228
	(% Site)	64.5	35.5	
	(% Total)	51.5	28.4	79.7
PgPw-3	(N)	20	8	28
	(% Site)	71.4	28.6	
	(% Total)	7.0	2.8	9.8
PhPo-3	(N)	11	19	30
	(% Site)	36.6	63.3	
	(% Total)	3.8	6.6	10.5
Total	(N)	178	108	286
	(%)	62.2	37.7	100

> discard of worn-out items...
> ...informants agreed that personal gear was inspected before going into the field so that worn items or items in need of repair were either repaired first or replaced before leaving for the field. This means that the discard of personal gear related to the normal wearing out of an item was generally done inside a residential camp, not in the field where the activity in which the item was used occurred (Binford 1979:263).

Finished artifacts may have been discarded on-site because of the ease with which they could be replaced. Scarcity of raw material was probably not a real constraint. This is suggested by the high frequency of preliminary modification debitage (some with minimal modification) in the sample. Schiffer (1972:158) hypothesizes that materials costlier in terms of procurement effort are used more economically than accessible, inexpensive raw material. Cast antler falls into the second category of material used less intensively, in part because of its availability.

In addition, manufacturing time may have been shortened by the use of metal tools (especially, iron and steel axes, saws and burins). These items would have probably expedited manufacturing processes such as initial longitudinal and transverse reduction. However, no information is available as to the time investment in manufacturing antler implements.

Sections (6.2%), blanks (4.6%), cores (2.7%) and preforms (3.5%) comprise only 17% of the sample of the three sites combined. This distribution, when compared with the numbers for debitage and finished artifacts, suggests that once a piece was selected and reduced to the stage of core material by the removal of extraneous parts, little incomplete processing was done. That is, material not discarded as preliminary reduction debitage was completely modified to the stage of recognizable preforms or finished products. This feature may suggest "efficiency" in tool production as a consequence of using metal tools and more precise processing techniques.

B. Strategies of Reduction

Low frequencies of secondary reduction material is also a reflection of processing strategies. Techniques that would create high frequencies of blanks and exhausted cores (grooving and splitting or breaking along drilled holes, for example) were used less than other reduction strategies (sawing or chopping). In the following figures the frequency of occurrence of each manufacturing process is plotted by stage of manufacture. The figures were generated by first combining the counts for attribute categories describing each manufacturing process (grooving, whittling/scraping, cutting/sawing, chopping, and drilling) for each stage of manufacture (debitage, section, blank, core remnant, preform, product). Then, a frequency of occurrence percentage was computed for each stage of manufacture. For example (see Figure 5), 56.5% of all grooving attributes occur on debitage, 2.4% on sections, 16.9% on blanks, 21.8% on cores, 0% on preforms, and 2.4% on products. These figures were generated in order to schematically represent overall trends in manufacturing strategies. The total sample, 627 artifacts from the Kuptana, Haogak and Nasogaluak sites is considered together, in order to analyze general trends in technology. Then individual site differences are considered. By this approach, the analytical results can be fitted back into the process model developed in Chapter Four, because it can be seen that certain techniques occur most frequently at preliminary reduction stages, while others represent finishing strategies.

It was suggested in the discussion of the reduction model that preliminary reduction strategies include techniques for removing a desired section or blank from the parent material. Processes include grooving, cutting and sawing, and chopping.

As demonstrated in Figure 5, grooving attributes are present in highest frequency on debitage and cores, as one strategy for removing blanks from cores. Grooving attributes occur 70 times on debitage (56.5%), 27 times on core remnants (21.8%), and 21 times on blanks (16.9%).

Cutting and sawing attribute states are found most frequently on debitage (N=289, 48.5%) (Figure 6). This result suggests that saws and knives were used to section whole antlers for further processing of extracted sections and blanks. Other attributes related to cutting and sawing processes and in highest frequency on preliminary modification debitage are snapped (N=106), tines removed (N=66), and cut marks (N=40) (see Table 5, pages 97-98).

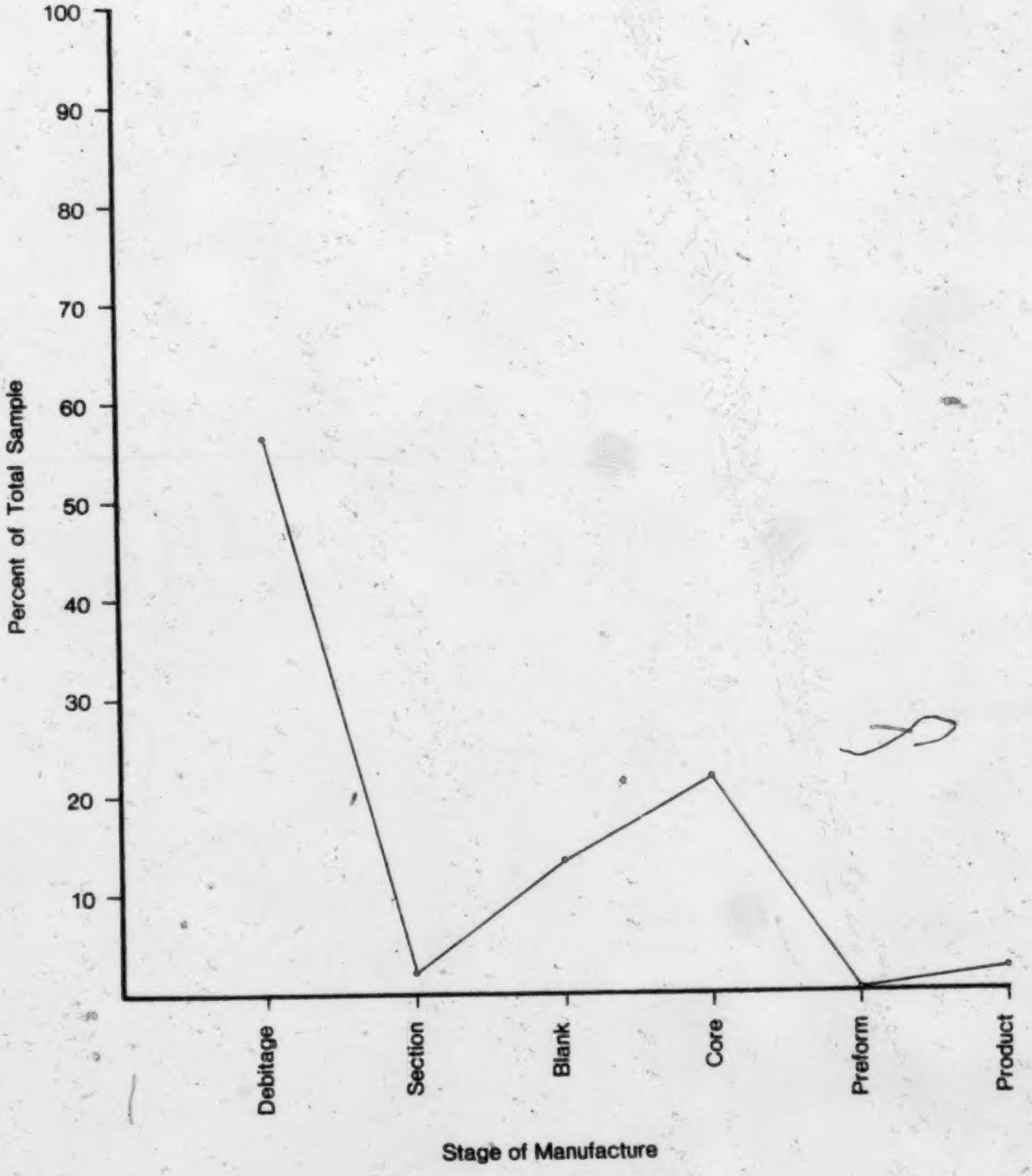


Figure 5. Frequency of Grooving by Stage of Manufacture.

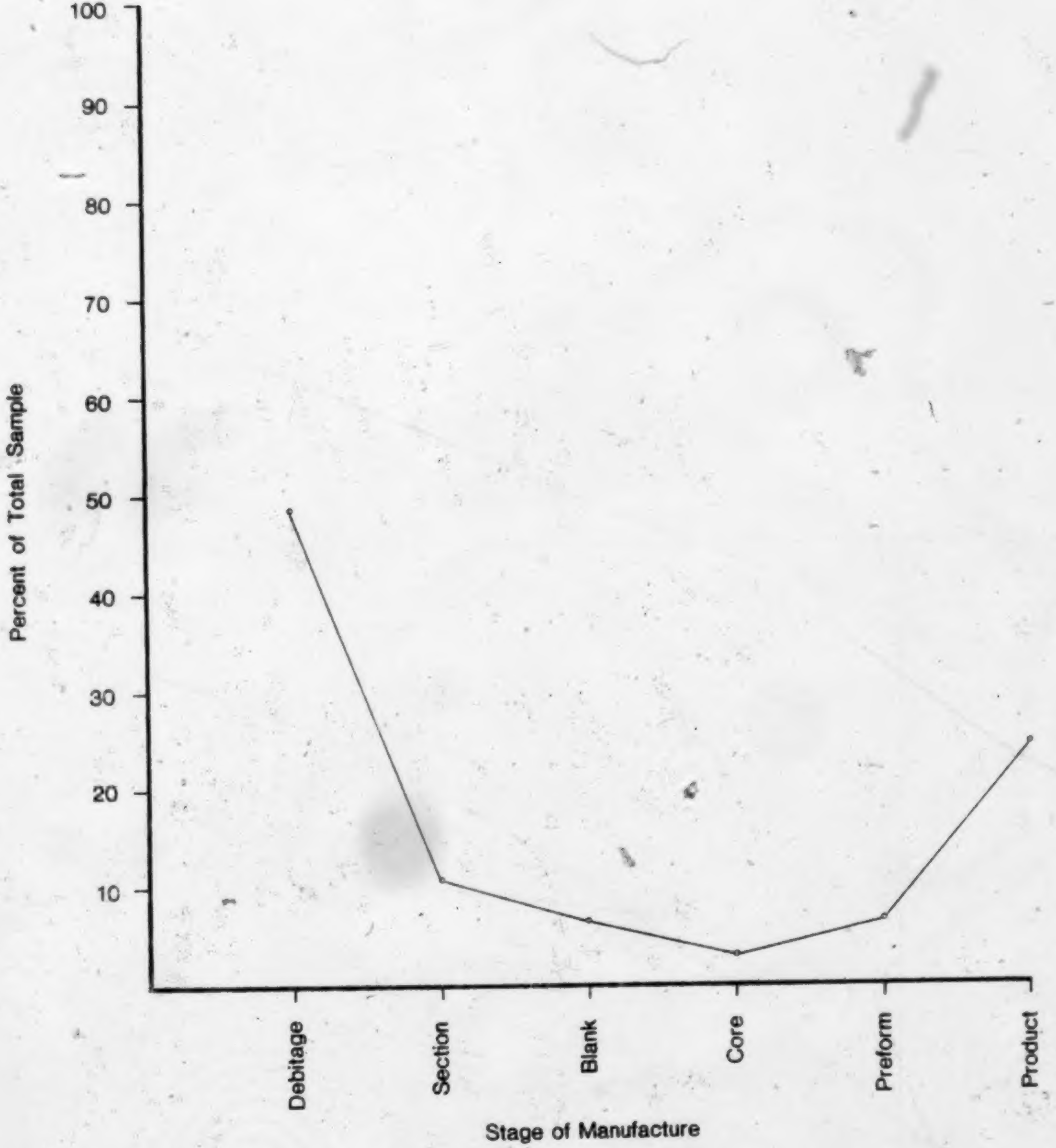


Figure 6. Frequency of Sawing and Cutting by Stage of Manufacture.

Chopping also occurs most frequently on debitage. Chopping on the ends of pieces to separate them was coded 29 times on preliminary modification debitage. pieces. This method was used to separate pieces for further reduction.

In the reduction model, secondary reduction techniques were described as those used to further shape a selected piece (section or blank) once it has been obtained from the core material. Suggested processes included surface treatments such as chopping, and whittling and scraping. The low numbers of identified sections, blanks and preforms at all sites makes it difficult to generalize about processes involved at this stage of manufacture. Attributes recorded on blanks and preforms include: grooving, cutting and sawing, and whittling (Figures 5-7; Table 7, pages 114-115; and Table 9, pages 118-119).

The presence of grooves on blanks results from strategies to extract the blank from the original raw material. Specific attributes are Groove Full Length (N=6) and Groove and Split (N=12) (see Table 7). Both of these attributes described groove remnants still visible on one or both lateral edges of the blank, which would be obliterated by any further surface modifications.

Cutting and sawing of sections and blanks includes cutting the ends of the piece. This strategy is related to attempts to reduce the material longitudinally to a shape approximating the finished product.

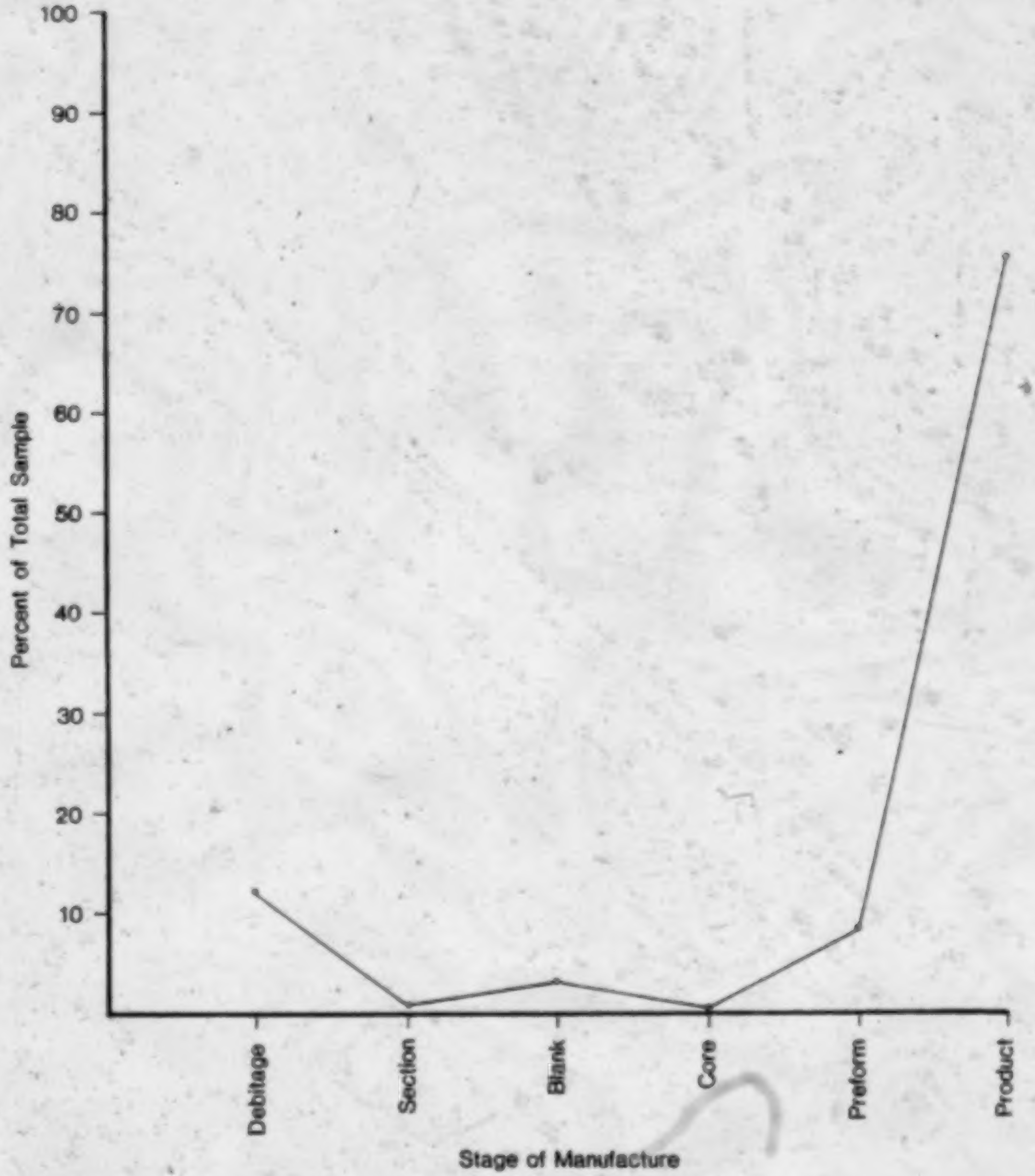


Figure 7. Frequency of Whittling and Scraping by Stage of Manufacture.

Only seven cases of chopping were scored on blanks (Figure 8). Four of these cases involve chopping along the lateral edge(s). Chopping in this manner served to remove cortex material from the beam, thus transversely reducing the size. The amount of debitage thought to result from chopping is much higher than the actual numbers of blanks possessing evidence of that modification. Wedge-shaped splinters of cortex bone and shavings result from this process, as suggested by experimental results. One explanation for the disparate numbers of blanks versus debitage is that chopping modification, as an intermediate stage of processing, is obscured on products by final surface treatment like whittling or scraping.

Finishing processes were described as those used for surficial treatment of preforms. Scraping and whittling techniques shape and smooth the surface. The attribute states of Ventral Face Whittled (N=117, 77.5%) and Dorsal Face Whittled (N=113, 78.5%) were identified most often on finished artifacts.

Cutting and sawing were used to create blade slots, lashing marks or hafting features. The attribute of a slotted blade end was observed 43 times on finished artifacts. The presence of this attribute is indicative of the high numbers of tool or knife handles within the sample of finished artifacts (80 handles or handle parts were identified). Lashing or hafting cut marks were present 48 times on products.

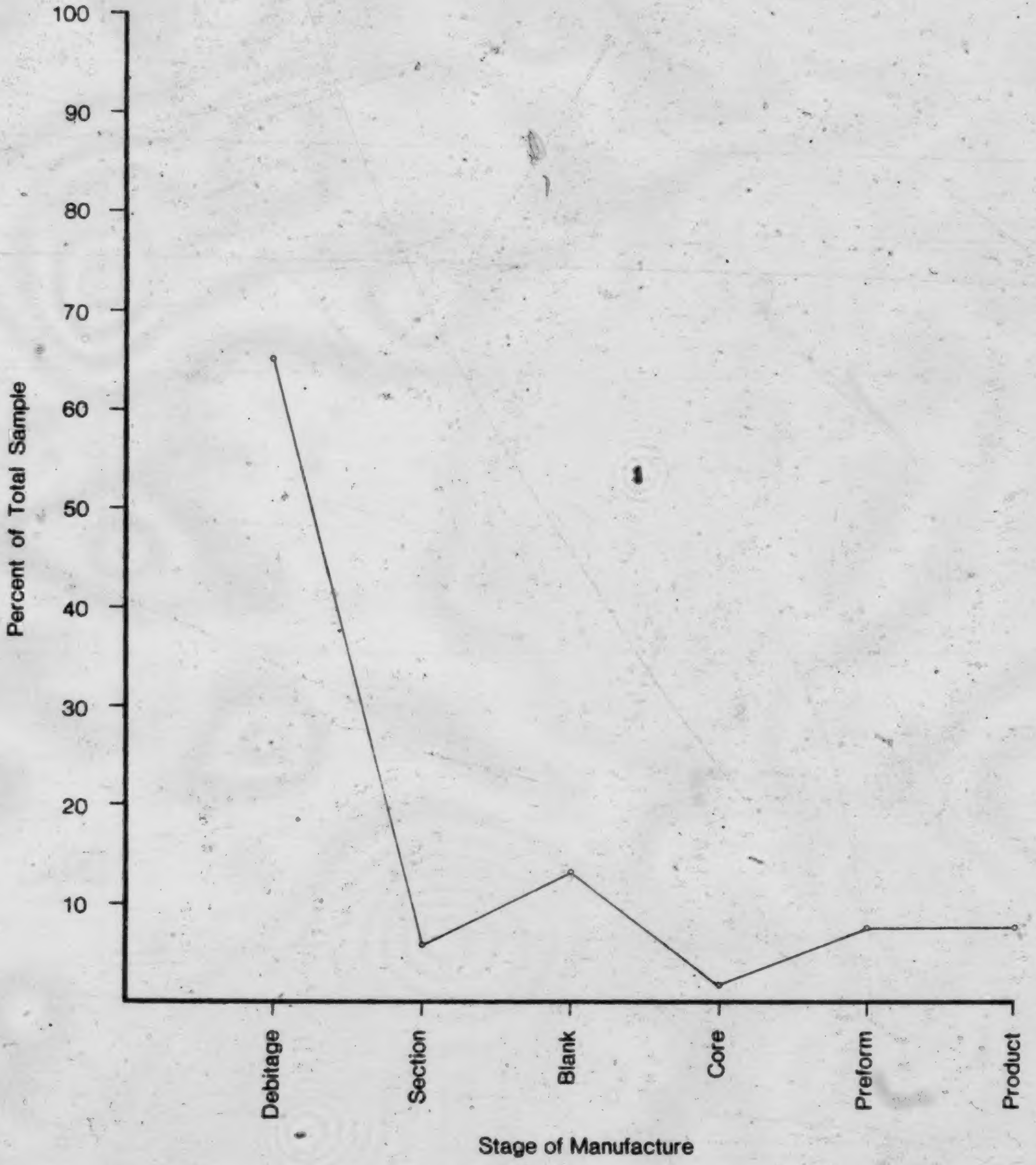


Figure 8. Frequency of Chopping by Stage of Manufacture.

Drilled holes are present on finished artifacts (66 counts of one or more drilled holes) (Figure 9). Blades were lashed or riveted to handles by drilled holes; handle splice sections (eg. whittling knives) were assembled in the same manner. Drilled holes also functioned to suspend objects from the handle, or to carry the tool (Jenness 1946).

C. Intra-and Inter-Site Comparisons

Spatial Distribution

Figures 10 - 12 are maps plotting the distribution of antler and stones larger than 20 cm in diameter at the three study sites. Not all artifacts are represented in the plots, since some were collected during excavation and were not photomapped. [For a description of the coding and plotting procedures, refer to Gibson et al. (1982).] The distribution of antler is compared with stones in order to observe whether a visual relationship can be observed between activity areas and structural features. It was postulated that antler processing activities at residential sites would correspond with tentrings, where tool production and maintenence activities might be likely to take place. Therefore, broken tools, discarded implements and manufacturing debitage ought to cluster near tentrings. This kind of association has been noted for !Kung Bushman habitation sites by Yellen (1977:88). Manufacturing debris is associated with hearth areas at the mouths of !Kung huts and these areas are loci for many different activities.

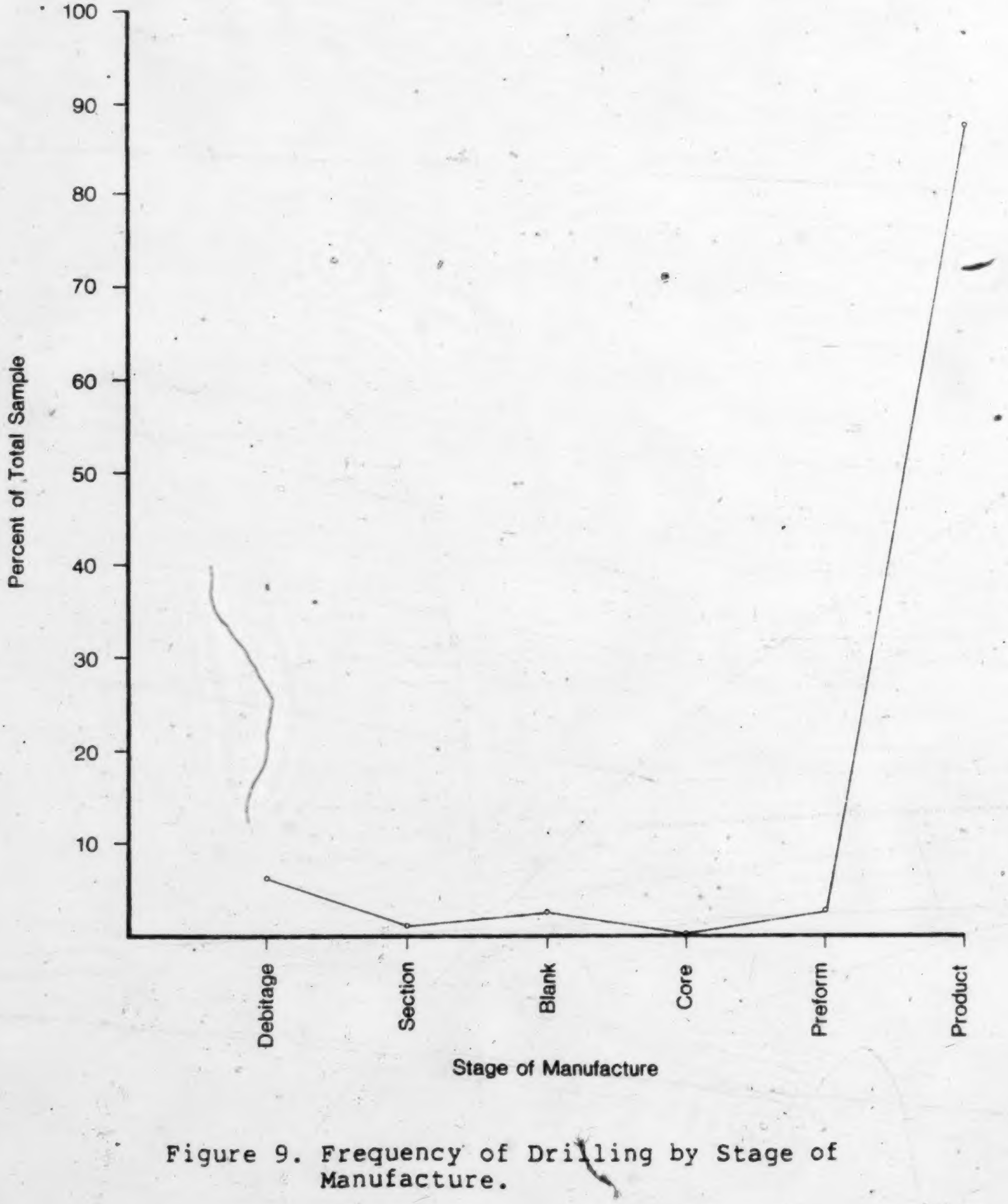
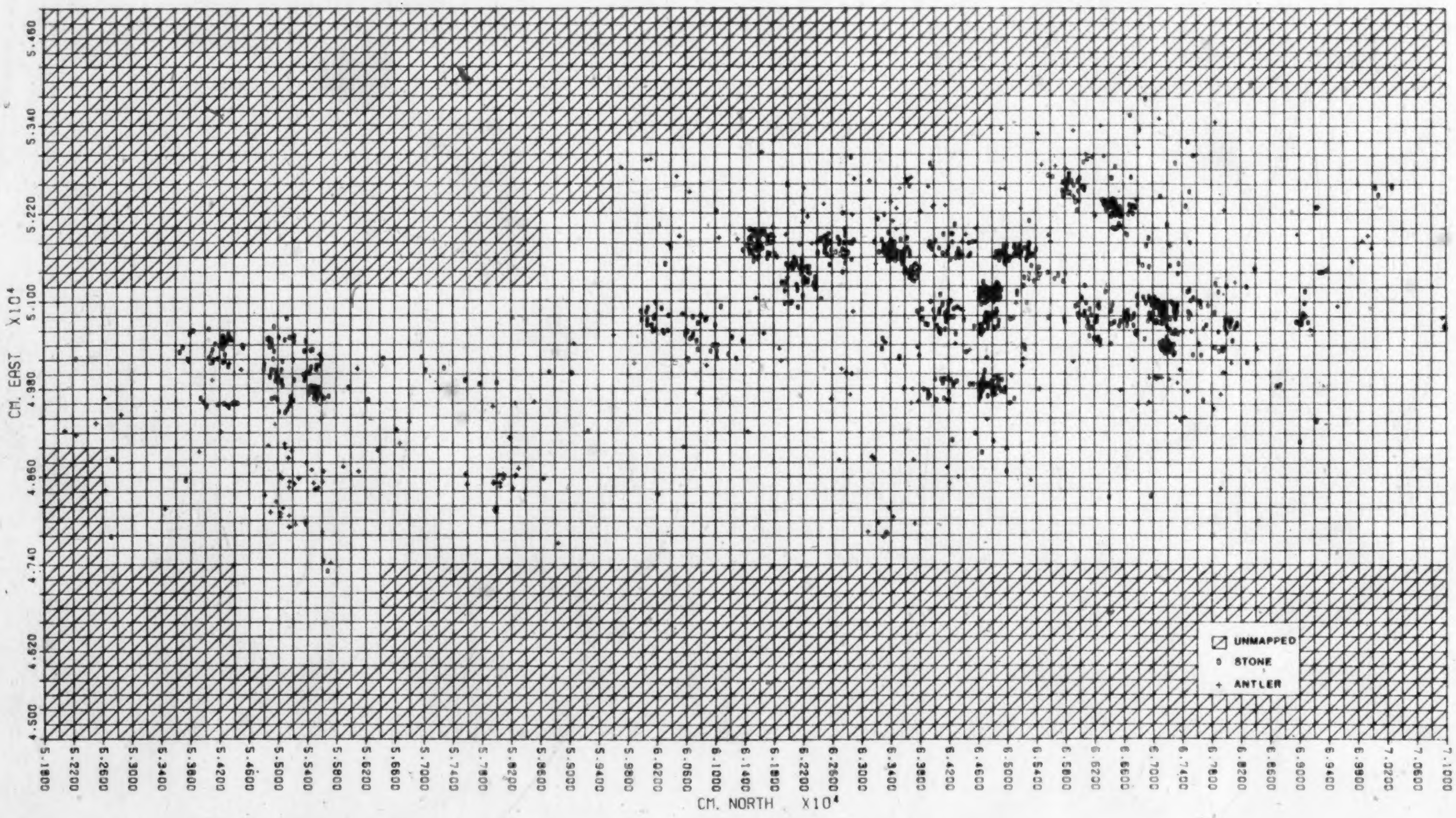


Figure 9. Frequency of Drilling by Stage of Manufacture.


5.460
5.340
5.220
5.100
4.980
4.860
4.740
4.620
4.500
CM. EAST X10⁴
5.1800
5.2200
5.2600
5.3000
5.3400
5.3800
5.4200
5.4600
5.5000
5.5400
5.5800
5.6200
5.6600
5.7000
5.7400
5.7800
5.8200
5.8600
5.9000
5.9400
5.9800
6.0200
6.0600
6.1000
6.1400
6.1800
6.2200
6.2600
6.3000
6.3400
6.3800
6.4200
6.4600
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6.5400
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6.9000
6.9400
6.9800
7.0200
7.0600
7.1000
CM. NORTH X10⁴
▨ UNMAPPED
0 STONE
+ ANTLER

Figure 10. Map of Antler and Stone Distribution at the Kuptana Site (PjRa-18).

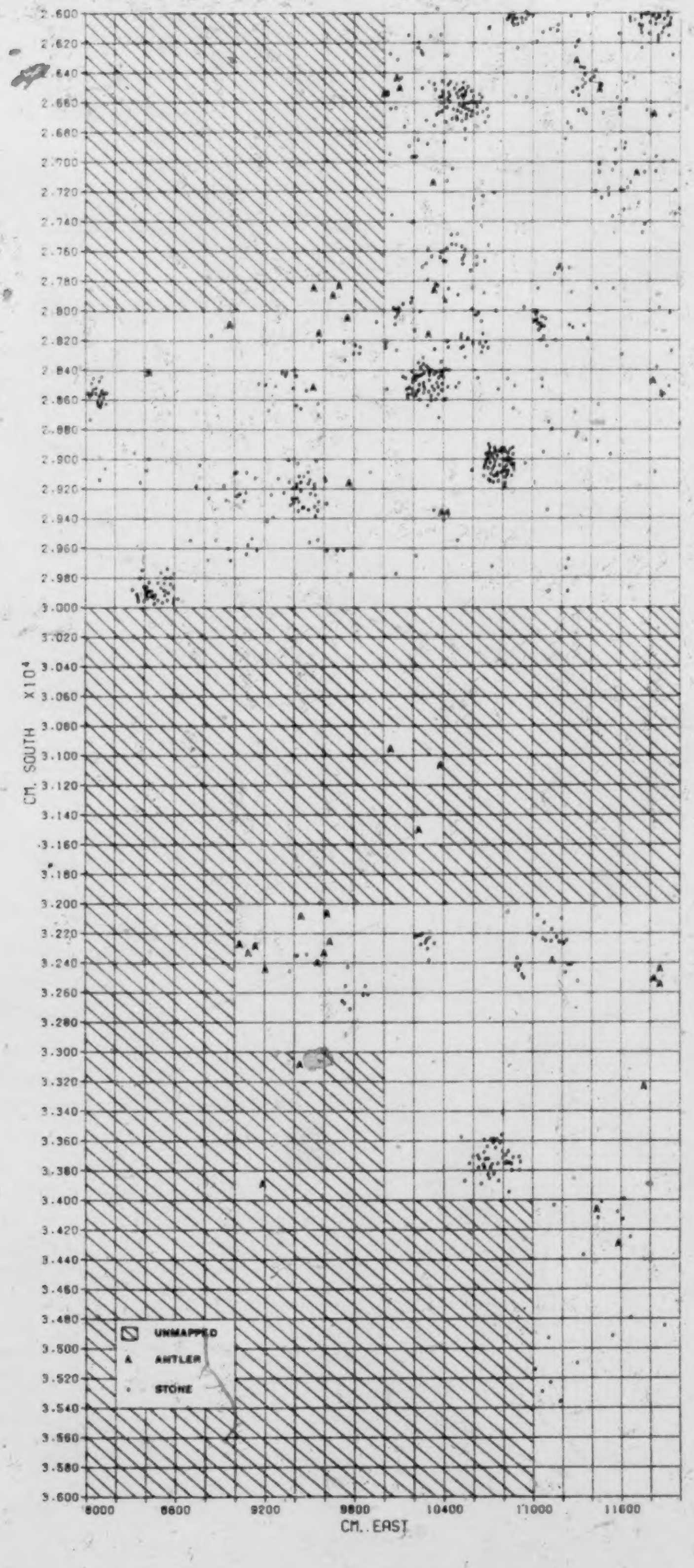
The plots tend to demonstrate a visual association between antler and tentrings, although the sample is small. One feature of interest is the association of products (finished artifacts) and structural features. At all sites, this class is found within and near tentring features. Conversely, debitage is more dispersed in distribution.

One observation made in the field but not clearly illustrated in the plots is that debitage was associated with rib rings. These features consisted of a circle of (often) standing muskox ribs, and were interpreted as skin stretching areas. Debitage was collected from some of these areas. In at least one case, an expedient tool made from an antler beam section was associated with a rib ring where it had been used in place of a rib.

Stages of Manufacture

A comparison of the frequency of artifacts between sites representing each stage of manufacture (Table 11, page 126) indicates little difference in the percentage of occurrence. The most obvious difference is the much larger sample from PjRa-18, corresponding to overall difference in site size and richness.

One difference is that a much higher percentage of debitage (56%, N=28) compared to finished artifacts (14%, N=7) is represented at the Nasogaluak Site (PgPw-3). The Kuptana (PjRa-18) and Haogak (PhPo-3) sites contain lower numbers of artifacts representing primary reduction stages


CM. SOUTH X10^4
2.600
2.620
2.640
2.660
2.680
2.700
2.720
2.740
2.760
2.780
2.800
2.820
2.840
2.860
2.880
2.900
2.920
2.940
2.960
2.980
3.000
3.020
3.040
3.060
3.080
3.100
3.120
3.140
3.160
3.180
3.200
3.220
3.240
3.260
3.280
3.300
3.320
3.340
3.360
3.380
3.400
3.420
3.440
3.460
3.480
3.500
3.520
3.540
3.560
3.580
3.600
8000
8600
9200
9800
10400
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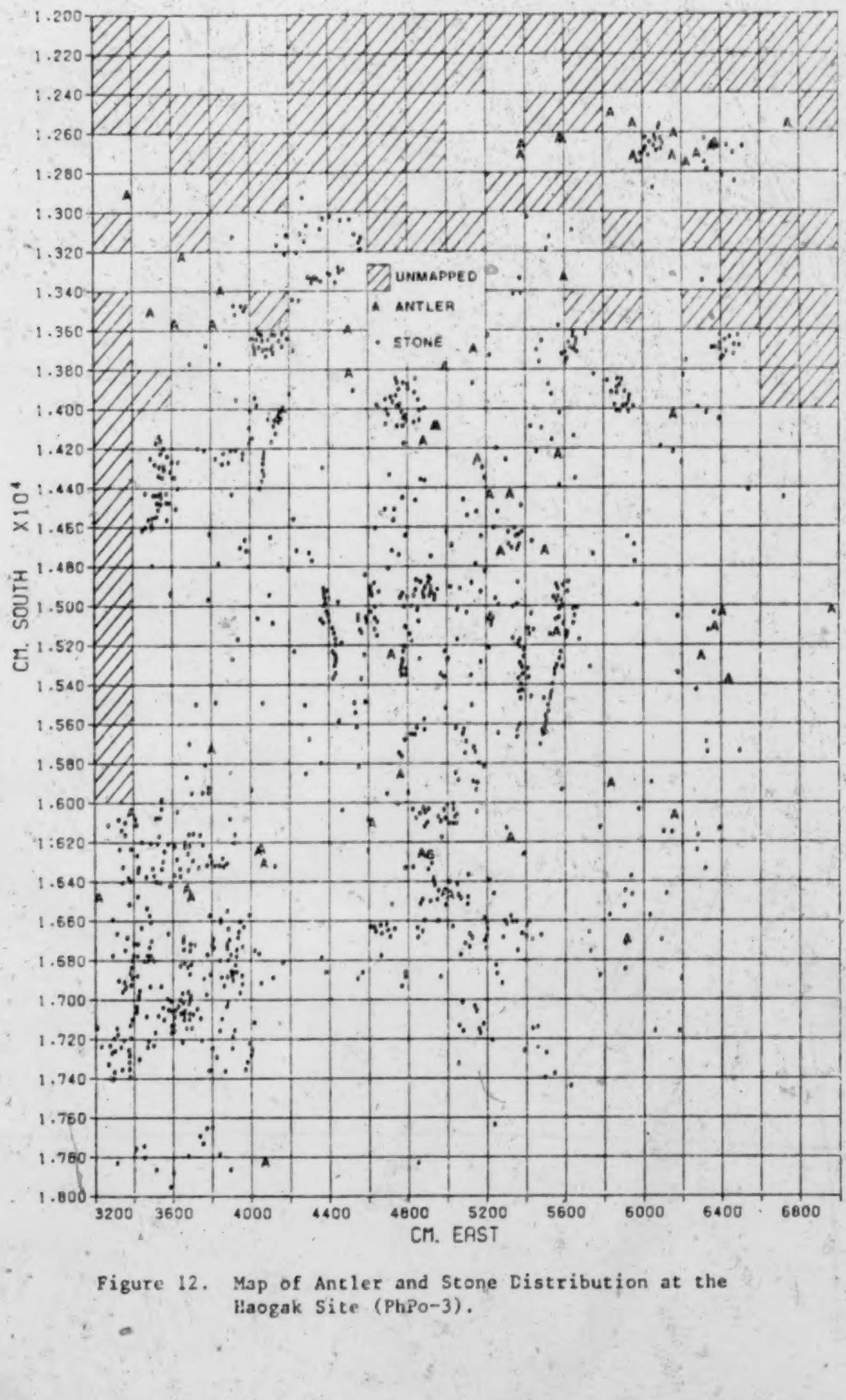
11600
CM. EAST
UNMAPPED
ANTLER
STONE

Figure 11. Map of Antler and Stone Distribution at the Nasogaluak Site (PgPw-3).



UNMAPPED
ANTLER
STONE
CM. SOUTH X10⁴
CM. EAST
1.200
1.220
1.240
1.260
1.280
1.300
1.320
1.340
1.360
1.380
1.400
1.420
1.440
1.460
1.480
1.500
1.520
1.540
1.560
1.580
1.600
1.620
1.640
1.660
1.680
1.700
1.720
1.740
1.760
1.780
1.800
3200
3600
4000
4400
4800
5200
5600
6000
6400
6800

Figure 12. Map of Antler and Stone Distribution at the Haogak Site (PhPo-3).

(PjRa-18: 44.5%, N=228; PhPo-3: 46.1%, N=30) and higher frequencies of finished artifacts (PjRa-18: 28.9%, N=148; PhPo-3: 29.2%, N=19). However, the ratio of primary modification debitage to other debitage is reversed at the Haogak Site (see Table 12); that is, more splinters and shavings occur in the site sample, suggesting modification processes related to surface treatment of artifacts. This feature has been interpreted as indicative of finished artifact production, maintenance, or curation.

These differences may be related to overall site "function" and length of occupation. If PgPw-3 represents a more temporary camp-cache site (Will 1984), then fewer finished artifacts would have been maintained and/or discarded there, following Binford's model of curated technologies discussed above. The Haogak Site may be the result of more prolonged, or repeated, habitation. The Kuptana Site, because of its large size and the probability that it is the result of numerous occupations, is difficult to interpret.

Faunal analysis indicates a difference in composition of muskoxen osteological remains between the Nasogaluak and Haogak Sites (Will 1984). This result suggests that at the Nasogaluak Site more hunting and carcass processing occurred away from the habitation area. Edible meat and bone parts were then returned to the site. At the Haogak Site, in contrast, entire herds may have been dispatched in the site vicinity, since a greater number of axial bone elements are represented there. Dental annuli analysis indicates a fall occupation of the Haogak Site as does the presence of heavy tentrings with excavated passageways (Hickey 1982). Artifact production may have been important in the fall, when tools were being made and repaired in preparation for winter activities (Jenness 1922a).

D. Technological and Material Culture Comparisions

Technological Features

Certain technological features described in other bone technology studies are low in frequency or absent in Copper Inuit technology. These include the groove and splinter technique, breaking a piece along a series of drilled holes, and surface grinding. It is suggested that the absence of these techniques reflects the use of metal tools and technological processes possible only with non-native tools such as saws.

Grooving occurs in lower frequency than sawing and cutting techniques for preliminary reduction. The classic groove and splinter technique has been described as a characteristic means for longitudinal division of bone in prehistoric technologies (Blaylock 1980; Clark and Thompson 1953; Will 1981). With the availability of saws, grooving and splitting or wedging-out of cores from beams may have been replaced by more controlled reduction strategies such as sawing. The shape of the blank produced would be more regular, since breaking the blank from the core would not be required to remove it. Jenness (1946:3) observed Inuit methods of cutting up large pieces of wood. By analogy, his description may be extended to methods for sectioning antler:

> Lacking saws, the Eskimos shortened a plank in one or other of three ways: they hacked it with the adze; gouged it across with the grooving tool; or they drilled a line of holes across it with the bow drill.

Cutting or sawing along the scour marks first created by a grooving tool may have been an important technique. The edges of some longitudinally severed sections retain remnants of incisions inferred to have been created by a grooving tool (see discussion in Chapter 4).

Another technique seen in low frequency in Copper Inuit technology is breaking a piece along a series of drilled holes. This technique for longitudinal reduction may have been more common prior to the availability of saws:

> In olden times, when iron was extremely rare and an effective saw could not be procured, they [Baffin Island Inuit] split the bone by drilling many holes, one close to the other, afterwards breaking the pieces asunder (Boas 1974:524).

Grinding, as a technique for surface shaping or finishing, was not definitely identified. Grinding is apparent by the presence of numerous small striations which are not usually oriented in a linear direction and often curve back on themselves (Will 1981:47). However deliberate grinding is difficult to distinguish from use-wear,

> ...when heavy striation is a feature of an intentionally ground surface [on stone tools] the striations are usually aligned in sets that can intersect each other because of alterations of the

> direction in which the tool was moved during grinding. Other intentionally ground surfaces display indistinct striations that cannot be clearly distinguished from use wear...(Kamminga 1979:154).

Grinding may not have been employed to create smooth, finished surfaces on antler tools because of the effectiveness of metal blades for shaping artifacts. Microscopic examination of archaeological specimens reveals parallel and linear striations on the surfaces. This morphology resembles experimental results as described for whittling in Chapter 3. The inference is therefore made that surface treatment was in large part accomplished with a whittling knife blade.

An alternative cause for the lack of surface grinding may be a trend toward stylistic and manufacturing "simplification" in Copper Inuit material culture. McGhee (1972:106, 116) attributes changes in form and loss of material culture items between Thule and historic Copper Inuit to stylistic simplification. He cites, for example, loss of more complex Thule types of harpoon heads, needle cases and decorative motifs in the historic period. This event may be coincident with the decline in ground slate use after the Thule Culture. That is, few implements were routinely being finished by grinding. However, items of copper were shaped and finished by grinding (Hickey, pers. comm.).

Jenness (1946:145) also noted an absence of decorative art in ethnographic Copper Inuit material culture:

> They [Copper Inuit] could have produced the delicate

> carvings and engravings in bone and ivory that we find in Alaska, and, to a lesser extent in the eastern Arctic, but the impulse was lacking. They did, it is true, engrave a few simple designs, and make a few rough carvings, mainly for fishing lines and needle-cases; but the "picture-writing" of the western Eskimo, and the naturalistic shapes given to toggles, drum handles, and many other objects were conspicuously absent.

Trends in Material Culture Change

As briefly discussed in Chapter Two, McGhee (1972) identified three trends in material culture change from Thule to historic Copper Inuit. The first, and least important for the discussion at hand, is loss of Thule artifact types important in subsistence whaling. However, since there is little evidence for whaling in any of the Thule sites described by McGhee (1972), the issue will not be addressed here.

The second trend is decline of older manufacturing techniques in favor of more effecient ones (McGhee 1972:105). Replacement of chipped stone by ground slate and metal and substitution of soapstone for pottery are noted here.

A third trend is change in formal and stylistic attributes of artifact types which persist through time. Formal changes identified include shape alterations in harpoons and other artifacts. Changes in tool handles are also noted and related to adaptations for metal blades. The tools affected are men's knives, adzes, scrapers and women's knives (McGhee 1972:109-110). Blade sockets decreased in size with use of thinner metal blades, for example. Stylistic simplification was discussed above.

While an analysis of material culture change is beyond the scope of this study, some suggestions for future research are made. A necessary prerequisite for such an analysis must be an adequate comparative data base for the critical time periods (eg. Thule and Intermediate Interval archaeological periods, the pre-ethnographic period considered here, and the ethnographic period).

Raw Material

The literature describing raw material changes through time was discussed in Chapter Two. This evidence indicates that another important feature of change that relates to antler technology is ubiquitous use of metal tools to modify antler. Archaeological and historical sources pertaining to the eighteenth and nineteenth centuries indicate, not surprisingly, that metal tools are less common than in historic Copper Inuit collections. Ground stone, bone and antler arrowheads, fishing implements (hooks, leister barbs), and antler or copper adzes were replaced with either copper, iron or steel by the ethnographic period. It is suggested here that differential replacement of local resources by copper or iron and steel occurred. Iron and steel was most often used for antler-working tools (adzes, grooving tools, whittling knives, saws), while copper was used in hunting implements (arrowheads, fish hooks), snowknives, traded items, etc. For example, McGhee (1972) reported an antler adze or axe head from the Thule Memorana site. Hearne (1958) described copper adzes in the Inuit camp at Bloody Falls. By the ethnographic period only steel or iron adzes were in use (Birket-Smith 1945; Jenness 1946; Stefansson 1919). This trend is documented by Jenness (1922b) for the post-1910 historic period. It is suggested here that that trend began earlier, when large amounts of exotics became available from the Mercy Bay cache.

Suggestions for Future Research

This last discussion can only be considered suggestive of avenues for future research. The conclusions presented here are that (1) iron and steel tools, and especially saws, were used to modify antler in the archaeological site sample, and (2) literature cited suggests replacment of local raw materials by imported metal tools for antler-working and (3) technological features such as the groove and splinter technique, drilling holes to section pieces and surface grinding were infrequently observed on specimens, whereas other techniques like cutting and sawing were higher in frequency and are related to use of metal tools. These conclusions could be tested more directly by examining the archaeological and ethnographic collections for suggested features of raw material type, manufacturing technology and trends in material culture change.

First, pertinent ethnographic collections could be analyzed for evidence of technological features, in a manner similar to that employed in this study. It is expected that the results would indicate a close similarity in antler technology. Such an approach ideally requires a comparable sample of all stages of manufacture; since finished artifacts are often the only items collected by ethnographers, the sample is probably lacking. However, it would be possible to compare collections for probable antler modifying tools, and technological features still observable on finished artifacts. These latter would include, for example, whittling and scraping or surface grinding.

Second, Thule and Intermediate Interval archaeological assemblages could also be analyzed to make technological comparisons. Frequencies of technological attributes on antler artifacts could be computed. It is expected that the results would be different from those from this study; they should reflect different strategies of reduction. For example, attributes related to sawing should not be present, while drilling holes to split sections should be more common.

In a similar manner, stages of manufacture classifications could be made on the archaeological assemblages. These, too, should reflect different strategies of reduction related to availability and use of different tools and raw materials (for example, use of burins and wedges for splitting and removing sections, or stone adzes for chopping).

It may be possible to make inferences about "efficiency" by comparing the relative frequencies of stages of manufacture in assemblages (see page 130). A method to measure this feature might be developed by calculating the numbers of "mistakes" or "rejects" in samples of sections, blanks, core remnants and preforms. The reasoning is that less precise processing techniques (eg. grooving and splitting as opposed to sawing or grooving and cutting) might increase manufacturing failures.

In addition to comparable analyses of collections, other research projects may prove fruitful. The experiments conducted, while useful, were by no means exhaustive. As stated previously, the experiments were exploratory; they were designed to provide insights into potential techniques that might be important in antler technology. Experimentation to compare different metal tools (copper, iron, and steel) in long-term use and use-wear analyses might provide indications of how quickly blades dull and become ineffective. The Copper Inuit used cold-hammering to work copper (C. Hickey, pers. comm.), so that it was intractable to recycling. If copper tools were quickly worn down, they may have been less useful for antler working, and therefore more quickly replaced with harder metal tools from the Mercy Bay cache.

Finally, this study has demonstrated the utility of looking at total assemblage composition for making statements about technology and material culture. For one, debitage classification provides clues to raw material acquisition and manufacturing techniques. It may also be possible to look at the relationship of material culture and other aspects of culture (eg. Binford's (1979) concept of curated technologies). Here, an attempt was made to relate differences in subsistence patterns at the study sites with patterns of artifact production. In conclusion, a case has been made for the importance of a technological analysis in archaeological interpretation. This result should be kept in mind in the planning and implementation of field research designs. More than just finished artifacts should be collected from sites, where other classes of organic remains are preserved.

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APPENDICES I AND II

KEY

*	Pm - preliminary modification debitage; D - by-product debitage; S - section; B - blank; C - core remnant; Pf - preform; Pd - product In - indeterminate
**	B - beam; T - tine; Pd - pedicle; NA - no identification could be made
***	1 - mild weathering and minimal lichen growth; 2 - moderate weathering, splitting and lichen growth; 3 - severe weathering, exfoliation and lichen growth; 4 - animal chewing on tips; 5 - animal chewing on other parts; 6 - broken.
SC	surface collection

APPENDIX I

Artifacts Used in Analysis

Site	Artifact No.	Provenience	Stage of Manufacture*	Length	Width	Thickness	Anatomical Part**	Taphonomic Process***
PjRa-18	80/40	696/503	Pd	NA	31	17	B	1,6
	80/28	674/501	Pd	NA	11	6	NA	1,6
	80/35	678/499	Pm	45	25	17	B	1
	80/33	684/504	Pd	NA	11	7	NA	1,6
	80/48	698/504	B	NA	NA	NA	NA	1
	80/38	692/513	Pd	NA	11	7	NA	1,6
	80/43	698/501	Pm	91	79	22	B,T	2
	80/74	708/501	Pd	141	20	11	B	2
	80/65	702/509	S	NA	30	27	B	1,6
	80/73	710/508	Pd	NA	26	11	NA	1,6
	80/61	702/505	Pd	94	14	8	T	1
	80/52	700/510	Pd	NA	16	8	B	1,6
	80/87	718/506	D	NA	NA	NA	NA	NA
	80/93	722/499	Pd	33	6	6	NA	1
	80/82	718/501	Pm	114	31	15	B,Pd	2
	80/92	720/513	Pd	NA	14	15	B	1,6
	80/86	718/510	Pd	NA	18	12	B	1,6
	80/94	722/507	Pd	NA	20	8	B	1,6
	80/78	712/510	Pm	65	47	9	T	1
	80/100	728/508	Pd	NA	10	4	NA	1,6
	80/14	644/501	Pf	63	11	7	T	1
	80/23	654/530	Pm	87	26	9	T	2
	80/11	642/501	B	NA	22	12	T	1,6
	80/22	654/504	Pd	NA	19	13	B	1,6
	80/6	628/495	Pm	256	25	2	T,B	1
	80/119	722/512	Pd	200	39	20	B,T	2
	80/126	734/509	Pd	NA	17	7	B	1,6
	80/101	728/510	Pf	80	14	12	NA	1
	80/104	728/512	Pd	NA	23	7	NA	1,6
	80/121	728/514	Pm	131	31	15	T	2
	80/103	728/511	Pd	223	12	14	B	1
	80/124	732/511	Pd	NA	31	15	B	1,6
	80/116	714/506	S	179	23	16	B	1
	80/115	730/512	Pd	NA	23	8	B	1,6
	80/113	732/508	Pd	NA	39	5	B	1,6
	80/102	728/510	Pm	81	14	9	T	1
	80/108	730/508	Pm	63	32	14	T	1
	80/120	726/503	Pm	150	25	19	T	1
	80/117	718/511	S	430	24	20	B	1

Site	Artifact No.	Provenience	Stage of Manufacture*	Length	Width	Thickness	Anatomical Part**	Taphonomic Process***
PjRa-18	80/140	740/504	Pd	94	70	14	P	1
	80/144	740/506	Pd	71	26	3	NA	1
	80/138	740/499	Pd	65	7	4	NA	1
	80/150	740/509	Pd	130	21	10	B	2
	80/132	738/502	Pf	215	23	13	T	1
	80/217	768/504	Pf	132	50	30	B	1
	80/221a	770/499	B	NA	37	15	B	1,6
	80/203	762/511	Pm	69	20	20	T	1
	80/219	770/499	S	40	22	16	B	1
	80/211	766/510	S	115	26	20	B	2
	80/204	762/515	Pm	130	26	20	B,Pd	2
	80/224	770/503	Pd	55	9	23	NA	1
	80/213	768/499	Pm	171	30	22	B	1
	80/221	770/499	Pm	125	26	8	B	2,6
	80/201	762/503	Pd	56	10	6	NA	1,6
	80/208	766/501	Pd	70	32	20	B	2
	80/212	766/512	Pm	350	37	28	B,T	2,4
	80/172	748/499	B	208	24	15	B	3,6
	80/157	742/505	Pd	65	14	8	NA	1,6
	80/153	742/503	Pm	99	41	12	T	1
	80/152	742/499	Pm	68	38	10	T	1
	80/168	746/502	Pm	249	20	16	B	2,4,6
	80/174	748/513	Pd	87	18	16	B	2
	80/164	742/510	C	125	77	11	P,T	1
	80/154	742/505	Pm	NA	23	14	T	2
	80/163	742/509	Pd	421	38	5	P	2
	80/159	742/505	Pf	121	26	11	B	1
	80/175	748/513	Pd	106	24	4	B	2
	80/167	744/510	S	63	25	29	B	1
	80/155	742/505	D	148	31	10	T	1
	80/178	750/512	B	196	25	15	B	2
	80/248	776/511	Pf	103	62	17	P	2
	80/181	752/503	Pm	86	15	12	T	2
	80/180	752/503	Pm	112	21	11	T	2
	80/176	748/515	B	59	26	6	NA	1
	80/187	756/509	Pd	115	22	20	B	2,6
	80/188	756/515	Pm	133	30	15	T	2
	80/183	752/507	Pd	NA	30	27	B	2,6
	80/191	758/501	Pd	NA	21	13	B	1,6
	80/195	758/515	Pf	120	55	11	NA	2
	80/194	758/513	Pm	162	32	16	P,T	2
	80/185	760/515	Pm	112	38	15	P	2

Site	Artifact No.	Provenience	Stage of Manufacture*	Length	Width	Thickness	Anatomical Part**	Taphonomic Process***
PJRa-18	80/199	760/515	Pm	165	37	15	T	3
	80/249	776/509	Pm	185	20	19	B	3
	80/239	672/499	Pf	41	11	7	NA	1
	80/227	672/499	Pm	NA	49	27	B,T	3,6
	80/256c	SC	Pm	335	41	16	B,T	2
	80/234	774/499	S	291	31	26	B	2
	80/250	778/506	Pd	150	35	27	B	2
	80/236	774/503	Pd	NA	14	13	T	1,6
	80/230b	772/503	Pf	37	13	7	T	1
	80/235	774/501	Pd	70	22	10	B	3
	80/241	774/506	Pd	NA	12	9	NA	1,6
	80/244	774/510	Pf *	NA	36	28	B	2,6
	80/254	SC	D	NA	NA	NA	NA	NA
	80/252	778/512	Pm	131	116	21	B,T	1
	80/256b	SC	B	215	31	18	B	2
	80/251	778/510	Pm	230	36	17	T,B	2,4
	80/246	137	Pd	39	20	B	2	
	80/243	778/507	Pd	NA	15	7	NA	1,6
	80/229	772/504	Pd	112	35	7	B	1
	80/270	TR 2	Pf	115	13	8	NA	1
	80/269	TR 2	D	245	19	15	B	1
	80/283	TR 3	Pm	NA	28	13	T	1,6
	80/296	TR 3	D	78	28	10	B	1
	80/281	TR 3	D	135	34	10	B	1
	80/284	TR 3	Pm	12	18	10	T	1
	80/297	TR 3	B	41	23	16	B	1
	80/279	TR 3	Pd	94	36	6	B	1
	80/286	TR 3	D	100	20	10	B	1
	80/337	TR 4	D	NA	NA	NA	NA	NA
	80/300	TR 4	Pm	174	42	18	P,T	2
	80/328	TR 4	Pd	NA	26	21	B	1,6
	80/335	TR 4	D	NA	NA	NA	NA	NA
	80/302	TR 4	B	37	36	10	B	2
	80/321	TR 4	Pd	43	8	4	NA	1
	80/301	TR 4	Pd	NA	15	7	NA	1,6
	80/307	TR 4	Pd	97	17	11	T	2
	80/336	TR 4	Pd	27	17	12	NA	1
	80/350	TR 5	Pd	NA	23	14	B	1,6
	80/379	TR 6	S	62	34	13	T	1
	80/341	TR 5	B	47	15	8	NA	1
	80/363	TR 5	Pm	78	18	11	T	1,4
	80/370	TR 5	Pd	133	15	5	B	1

Site	Artifact No.	Provenience	Stage of Manufacture*	Length	Width	Thickness	Anatomical Part**	Taphonomic Process***
PjRa-18	80/369	TR 5	Pm	141	55	13	T	1,4
	80/361	TR 5	Pd	NA	9	9	NA	1,6
	80/339	TR 5	Pm	177	44	20	B,T	1
	80/340	TR 5	Pm	87	13	10	T	3
	80/346c	TR 5	D	30	21	8	NA	1
	80/378	TR 6	Pd	NA	11	8	T	1,6
	80/399	TR 6	Pd	65	22	5	NA	1
	80/377	TR 6	Pd	36	87	2	NA	1
	80/401	TR 6	Pd	NA	12	7	NA	1,6
	80/382	TR 6	Pf	50	11	6	NA	1
	80/386	TR 6	Pd	NA	19	10	B	1,6
	80/383	TR 6	Pd	58	12	10	T	1,6
	80/400	TR 6	Pd	NA	47	8	P	1,6
	80/397	TR 6	Pd	NA	26	21	B	1,6
	80/414	TR 6	D	NA	NA	NA	NA	NA
	80/409	TR 7	Pd	NA	23	9	B	1,6
	80/405	TR 7	Pm	121	30	13	T	1
	80/412	TR 7	Pm	100	74	12	T	1
	80/413	TR 7	D	NA	NA	NA	NA	NA
	80/434a-d	TR 7	Pd	NA	NA	NA	NA	NA
	80/437	TR 7	Pd	55	8	6	NA	1
	80/438	TR 8	Pd	NA	NA	14	NA	1,6
	80/432	TR 8	Pd	NA	16	12	NA	1,6
	80/433	TR 8	Pd	NA	NA	5	B	1,6
	80/424	TR 8	Pd	NA	16	10	B	1,6
	80/435	TR 8	Pd	84	NA	17	T	1,6
	80/439	TR 8	Pd	NA	16	7	NA	1,6
	80/440	TR 8	Pd	NA	NA	4	NA	1,6
	80/436	TR 8	Pd	NA	8	6	NA	1,6
	80/420	TR 8	Pd	173	26	24	B	1
	80/518	TR 8	Pd	NA	26	24	B	1,6
	80/451	TR 10	Pm	NA	18	18	B	2,6
	80/453	TR 10	Pd	71	15	13	T	1
	80/458	TR 10	Pd	51	12	9	NA	1
	80/449	TR 10	Pf	NA	32	11	B	1,5
	80/464	TR 11	D	NA	NA	NA	NA	3,6
	80/468	TR 11	Pd	NA	9	8	NA	1,6
	80/469	TR 11	Pd	NA	12	8	NA	1,6
	80/473	TR 11	Pm	108	70	18	P,T	2
	80/467	TR 11	Pd	NA	NA	NA	NA	1,6

Site	Artifact No.	Provenience	Stage of Manufacture*	Length	Width	Thickness	Anatomical Part**	Taphonomic Process***
PjRa-18	80/470	TR 11	Pd	NA	23	10	B	1,6
	80/471	TR 11	Pd	115	42	18	B	2
	80/477	TR 12	Pd	78	9	4	T	1
	80/478	TR 12	D	184	17	6	B	1
	80/479	TR 12	Pd	NA	18	6	NA	1,6
	80/484	TR 13	D	143	31	18	B	1
	80/485	TR 13	D	148	30	18	B	1
	80/492	TR 14	Pd	65	12	14	NA	1
	80/490	TR 14	Pd	139	20	20	B	1
	80/503	TR 14	Pd	14	30	23	B	1,6
	80/498	TR 14	Pd	NA	20	10	B	1,6
	80/488	TR 14	Pm	220	33	21	T	1
	80/515	TR 15	Pd	100	31	18	T	1
	80/512	TR 15	Pd	64	29	20	B	1
	80/513	TR 15	Pd	NA	11	9	NA	1,6
	80/511	TR 15	Pd	NA	19	10	B	1,6
	80/518	TR 15	Pd	NA	19	9	NA	1,6
	80/526	TR 15	Pd	NA	37	6	B	1,6
	80/520	TR 15	Pd	NA	28	4	B	1,6
	80/510	TR 15	Pd	NA	17	4	B	1,6
	80/516	TR 15	Pd	NA	11	6	NA	1,6
	80/506	TR 15	Pd	NA	14	5	NA	1,6
	80/525	TR 15	Pd	22	11	4	NA	1
	80/529	TR 16/17	D	NA	NA	NA	NA	NA
	80/508	TR 17	D	NA	NA	NA	NA	NA
	80/531a	TR 17	Pd	24	5	4	NA	1
	80/531b	TR 17	Pd	20	5	5	NA	1
	80/537	TR 17	Pd	NA	29	28	B	1,6
	80/538	TR 17	Pd	NA	11	6	NA	1,6
	80/533	TR 17	Pd	NA	17	6	NA	1,6
	80/540	TR 17	Pd	NA	13	2	NA	2,6
	80/551	TR 18	B	130	25	16	T	2
	80/553	TR 18	Pd	NA	27	10	B	2,6
	80/547	TR 18	Pd	NA	14	10	NA	2,6
	80/552	TR 18	Pd	NA	16	5	NA	2,6
	80/550	TR 18	Pd	NA	15	6	NA	1,6
	80/588	SC	Pm	NA	28	18	B	2,6
	80/594	SC	Pf	316	50	23	B,T	3
	80/599	SC	Pm	82	22	6	B	2
	80/565	SC	Pd	65	33	14	NA	1

Site	Artifact No.	Provenience	Stage of Manufacture*	Length	Width	Thickness	Anatomical Part**	Taphonomic Process***
PjRa-18	80/570	SC	Pd	32	8	8	NA	2
	80/573	SC	S	85	36	30	B	2
	80/556	SC	Pm	193	43	14	T	2
	80/560	SC	Pm	142	26	13	T	1,4
	80/571	SC	Pm	139	30	15	T	2,4
	80/576	SC	Pd	NA	25	4	B	3,6
	80/554	SC	Pd	92	15	12	T	3,4
	80/579	SC	Pd	NA	16	11	T	2,6
	80/557	SC	S	196	19	14	T	2
	80/601	SC	Pd	108	13	6	NA	1
	80/581	SC	Pd	82	18	16	NA	1,6
	80/575	SC	Pd	105	37	15	B	2
	81/1	536/494	Pd	NA	NA	NA	T	1
	81/2	550/490	Pm	200	11	2	B,T	1
	81/3	542/484	D	NA	NA	NA	B,T	1
	81/4	510/498	Pm	188	17	10	T	1
	81/5	514/498	D	205	13	8	NA	1,4
	81/6	520/498	C	174	15	7	T	1,4
	81/7	554/496	In	190	16	6	T,Pd	1
	81/8	560/500	S	170	16	10	B	1,4
	81/9	574/494	Pm	232	11	4	T	3,4
	81/10	576/494	Pm	130	14	2	T	2
	81/11	580/484	D	70	5	3	T	3
	81/12	584/502	C	297	2	6	B	3
	81/13	590/480	D	110	13	2	T	1,4
	81/14	592/496	Pd	117	10	8	T	1,4
	81/15	596/512	D	114	12	1	T	1
	81/16	596/484	Pm	290	18	14	T	2,4
	81/17	600/502	Pm	110	11	11	T	4,7
	81/19	608/506	S	308	20	14	B,Pd	1
	81/18b	600/494	In	479	22	11	B,Pd	3,4
	81/18a	600/494	C	NA	38	4	B	2
	81/20	602/476	C	NA	20	8	T	1
	81/21	614/494	C	178	17	10	B,T	2
	81/22	612/496	Pm	164	20	6	B,T	2
	81/23	610/516	D	220	14	7	T	1
	81/24	612/494	D	145	12	8	T	1
	81/25	616/504	Pm	NA	24	11	T	1,5
	81/30	622/518	Pm	220	5	13	T	1
	81/31	622/524	Pm	265	20	7	B,T	3

Site	Artifact No.	Provenience	Stage of Manufacture*	Length	Width	Thickness	Anatomical Part**	Taphonomic Process***
PjRa-18	81/32	618/502	Pm	NA	16	5	B,T	2
	81/33	628/524	D	110	9	4	T	1,4
	81/36	628/524	Pm	120	9	5	B	1
	81/37	630/524	S	85	14	8	P	1
	81/38	626/506	Pm	103	19	19	NA	1
	81/39	628/492	Pm	185	14	5	T	1,4
	81/40	626/496	D	213	22	6	NA	2,4
	81/41	626/498	B	240	27	6	B,T	1
	81/42	628/498	Pm	172	21	14	P,T	1,4
	81/43	626/498	Pm	158	12	4	P,T	3
	81/45a	636/526	B	147	18	11	B	3
	81/45b	636/526	Pm	144	7	4	B	3
	81/45c	636/526	Pf	63	14	4	NA	2
	81/45d	636/526	Pm	82	9	8	T	1,4
	81/45e	636/526	S	127	9	19	B	2
	81/46	638/524	In	NA	28	5	P,T	2
	81/47	640/522	Pm	222	24	8	T	1
	81/49	642/522	B	52	14	13	P	1
	81/50	630/488	Pm	106	13	5	T	2
	81/51	632/504	Pm	119	16	7	T	1,5
	81/52	634/496	Pm	NA	17	5	P,T	1,4
	81/53a	638/502	Pm	213	15	6	NA	2,4
	84/53b	638/502	S	243	29	5	B	3
	81/54	636/502	Pm	186	39	22	B,T,Pd	1
	81/55	636/488	Pm	188	19	5	B,P	1
	81/56	642/494	Pm	240	14	7	T	1
	81/58	644/496	In	225	17	11	B	1
	81/60	644/502	Pm	380	21	11	B	2,4
	81/62	650/488	Pm	185	29	19	B,Pd	3
	81/63	648/492	B	120	14	3	NA	1
	81/64	648/496	Pm	264	14	6	B,T	2,4
	81/65	648/506	Pm	189	55	26	P,T	2,4
	81/66	650/502	S	232	47	21	NA	3,4
	81/67a	650/500	D	110	35	5	B	1
	81/67b	650/500	D	30	13	5	NA	1
	81/68	660/526	B	238	10	6	B	2
	81/69	662/528	Pm	110	31	13	NA	2
	81/70	664/496	Pm	190	16	7	T	1
	81/71	668/494	S	103	45	23	B	1
	81/72	666/496	Pm	193	34	18	T	1,4

Site	Artifact No.	Provenience	Stage of Manufacture*	Length	Width	Thickness	Anatomical Part**	Taphonomic Process***
PjRa-18	81/73	668/498	C	288	NA	23	B	1
	81/74	670/498	Pm	234	26	10	P,T	2,4
	81/75	668/492	D	122	25	5	B	2
	81/76	668/494	C	350	28	17	B	3
	81/77	674/496	S	192	20	16	B	3,4
	81/78	678/496	Pm	120	23	12	T	1
	81/79	678/498	Pm	190	12	10	NA	1
	81/80	678/496	C	450	30	16	B,T	3,4
	81/81	678/488	Pm	285	68	26	P	3
	81/82	678/500	Pm	210	28	5	B,T,Pd	1,4
	81/83	680/500	Pm	94	19	14	T	1,4
	81/84	672/516	Pm	262	40	28	B,Pd	3
	81/85	648/532	Pm	195	27	7	T	1
	81/86	654/532	Pm	104	52	17	P,T	2,4
	81/87	658/532	Pm	130	14	7	T	1,4
	81/88	662/532	Pm	208	60	21	NA	1,4
	81/90	604/518	B	118	34	19	B,Pd	1
	81/91	642/504	D	133	13	8	B	2
	81/92	604/526	Pm	355	NA	22	NA	1,4
	81/93	602/524	Pm	320	NA	21	T	2
	81/94a/b	688/498	S	125	41	25	B	3
	81/95	682/512	S	70	26	20	B	1
	81/97	682/520	Pm	247	18	7	P,T	1
	81/98	686/518	S	70	28	22	B	1
	81/99	688/510	Pm	178	54	21	T	1
	81/100	692/522	C	221	NA	20	T	1
	81/101	696/508	Pm	210	93	13	T	1,4
	81/102	698/514	D	70	12	12	B	2
	81/103	698/516	D	71	24	7	B	3
	81/104	698/516	In	38	28	10	NA	3
	81/105	690/504	Pm	91	32	18	T	2,4
	81/106	686/512	Pf	105	27	20	B	1
	81/107	708/510	Pm	130	27	7	T	3
	81/108	680/480	B	193	24	13	B	3
	81/109	688/484	Pm	200	35	17	T	2,4
	81/110	684/502	C	122	37	20	B	2
	81/111	648/488	In	111	NA	14	T	1
	81/113	638/514	Pm	105	20	11	T	1,4
	81/114	634/514	Pm	73	NA	16	T	2.4
	81/1a1	646/516	Pm	115	NA	11	T	2
	81/1a2	664/514	In	57	NA	9	T	1,4

Site	Artifact No.	Provenience	Stage of Manufacture*	Length	Width	Thickness	Anatomical Part**	Taphonomic Process***
PjRa-18	81/1a3	540/518	Pf	60	NA	16	T	1
	81/1a4	646/510	SC	200	NA	20	B	1
	81/1a5	658/514	Pm	110	NA	14	T	1
	81/1a6	446/482	Pm	191	17	7	P,T	3,4
	81/1a7	616/530	D	123	5	2	B	3
	81/27	618/516	Pm	237	NA	19	B,T	1,4
	81/28	618/518	S	256	20	13	T	1
	81/29	620/520	Pm	285	NA	16	B	1,4
	81/44	632/508	Pd	122	17	6	B	1
	81/120	440/512	Pm	98	17	13	T	1
	81/48	642/522	Pm	73	16	13	NA	1
	81/57	644/490	Pd	131	27	13	B	1
	81/34	628/524	Pd	66	14	12	NA	1
	81/1a	644/506	In	52	14	7	NA	1
	81/121	476.6/8.6	Pf	163	25	22	B	1
	81/200	678/524	Pf	166	23	11	B	1
	81/122	522.7/9.65	Pd	53	32	7	P	1
	81/199	672/510	B	204	88	16	T	1,4
	81/123	670/509	C	102	36	30	B	2
	81/124	670/510	B	118	31	12	T	1
	81/125	672/508	Pm	47	8	4	B	1
	81/126	640/506	Pd	NA	4	4	NA	1,6
	81/127	644/506	Pd	NA	19	11	B	1,6
	81/128	642/516	Pd	81	9	6	B	1
	81/129	646/506	Pd	NA	21	10	B	1,6
	81/130	668/504	Pd	32	20	14	B	1
	81/131	674/506	Pf	66	20	9	B	1
	81/132	674/506	D	65	23	7	T	1
	81/133	646/506	Pm	22	10	NA	NA	1
	81/134	632/518	D	105	20	8	B	1
	81/135	632/518	D	45	18	4	B	1
	81/136	672/502	D	56	5	4	NA	1
	81/153	672/503	B	68	13	9	B	1
	81/152	673/502	D	NA	5	[illegible]	NA	1,6
	81/150	674/502	Pd	92	18	6	B	1
	81/149	672/503	D	48	9	5	NA	1
	81/148	640/516	Pd	88	33	19	B	1
	81/2a	644/506	Pd	55	16	12	B	1
	81/59	634/514	Pd	70	19	6	B	1

Site	Artifact No.	Provenience	Stage of Manufacture*	Length	Width	Thickness	Anatomical Part**	Taphonomic Process***
PjRa-18	81/115	646/516	D	68	7	NA	B	1
	81/116	646/518	Pm	200	16	5	T	1
	81/117	646/516	D	81	5	5	NA	1
	81/118	634/514	Pd	NA	12	8	B	1,6
	81/119	632/518	Pd	61	5	NA6	NA	1
	81/138	634/516	Pd	137	NA	11	T	1
	81/139	634/414	Pm	44	11	NA	T	2,5
	81/140	634/514	Pm	NA	22	7	NA	1,6
	81/141	636/514	Pd	NA	17	5	B	1,6
	81/142	636/514	Pd	NA	18	3	B	1,6
	81/143	672/503	Pd	NA	20	13	B	1,6
	81/144	674/510	Pd	127	41	29	B	1
	81/145	671/504	Pm	55	14	17	B	1
	81/146	674/512	Pd	131	NA	12	T	2,4
	81/147	673/502	Pm	32	5	4	NA	1
	81/151	513/11.5	Pd	NA	12	7	NA	1,6
	81/201s	628/524	Pd	103	28	6	B	1
	81/35	450/50.7	Pd	202	17	6	P,T	1
	81/150	395/73.3	D	208	19	5	T	1
	81/151	440.4/97	D	205	19	5	T	3
	81/152	530.7/49.2	D	249	42	21	B	2
	81/153	504.4/21	C	114	43	20	B	1
	81/154	471.8/1.5	S	352	22	4	B	2,4
	81/155	479.6/63	D	98	42	14	T	2,4
	81/156	468.8/28	D	153	NA	19		
	81/157	498.5/75	D	36	115	30	T	2,4
	81/158	577.55/2.35	D	253	29	7	B	2
	81/159	469.3/73	D	NA	NA	NA	B	4,6
	81/160	517.7/18.1	In	250	NA	18	B	1
	81/161	503.4/78.2	D	25	25	25	B	1
	81/162	504.4/21	B	48	NA	26	B	1,4
	81/163	505.8/15.05	D	630	45	25	T	2
	81/164	448.5/5.5	D	290	NA	16	B	3
	81/165	488.85/6.8	D	240	NA	18	B,T	1,4
	81/166	543.3/69	Pm	297	NA	25	B	2
	81/167	481/74.8	C	514	38	36	B,Pd	1
	81/168	512.35/13.55	S	170	NA	18	T	2
	81/169	547.75/67	D	230	15	4	T	2,4
	81/170	522/51.1	D	190	17	6	T	1
	81/171	527.55/28.6	D	182	71	23	T	2

Site	Artifact No.	Provenience	Stage of Manufacture*	Length	Width	Thickness	Anatomical Part**	Taphonomic Process***
PjRa-18	81/172	487.55/28.6	Pm	249	28	26	B	1
	81/174	478.3/68	B	324	65	23	T	1
	81/175	504.5/47.6	D	225	19	8	B	2,4
	81/176	438.6/68.5	D	147	NA	20		
	81/177	498.5/76	D	244	18	12	T	1,4
	81/178a/b	506/1.7	D	141	22	13	T	1
	81/179	480.9/19.6	S	66	NA	11	T	1
	81/180	474.5/14.1	D	63	16	11	T	1
	81/181	452.1/7	Pm	127	NA	13	T	1
	81/182	477.5/13.7	D	88	21	15	T	1
	81/183	482.4/3.7	Pm	103	36	13	T	1
	81/184	508.65/63.3	Pm	NA	NA	NA	NA	2
	81/185	476.6/8.6	D	177	44	31	B	1
	81/186	512/2.7	S	39	10	7	T	1
	81/187	480.65/11.8	Pf	36	19	10	B	1
	81/188	475.8/8.6	D	268	NA	32	B	1
	81/189	469.3/73.9	D	199	NA	17	T	1
	81/190	469.6/81.3	Pm	200	NA	15	B	1,4
	81/191	547.7/67	D	280	NA	25	B	3
	81/192	509/58	Pm	382	NA	23	B	2
	81/193	469.6/71.3	Pm	274	NA	18	B	1,4
	81/194	579.6/73	Pm	287	NA	28	P,T	1,4
	81/195	509.7/12.7	D	130	15	14	T	1
	81/196	513/11.5	S	169	25	18	B	1
	81/197	SC	D	238	48	24	B	2
	82/1	608/486	Pm	NA	31	15	B	1,6
	82/2	610/474	Pm	145	41	15	P,T	1
	82/3	SC	Pd	NA	33	7	NA	1,6
	82/4	674/524	Pd	94	55	21	NA	2
	82/5	636/480	Pd	42	7	7	T	1
	82/6	634/492	Pd	NA	19	16	NA	1,6
	82/7	572/496	Pd	380	11	5	NA	1
	82/8	614/472	Pd	148	17	10	B	1
	82/9	SC	In	NA	NA	NA	B,Pd	3,4
	82/10	510/470	Pd	NA	NA	NA	T	1
	82/11	516/486	In	70	30	17	T	1
	82/12	556/486	D	48	14	7	NA	1
	82/13	592/496	D,Pm	NA	NA	NA	NA	2,4
	82/14	424	C	424	130	33	B,P,T	1
	82/15	636/496	Pf	NA	22	20	B	1,6

Site	Artifact No.	Provenience	Stage of Manufacture*	Length	Width	Thickness	Anatomical Part**	Taphonomic Process***
PjRa-18	82/16	558/480	Pm	NA	NA	NA	NA	2,6
	82/17	558/480	B	80	52	23	B	1
	82/18	520/492	Pm	17	13	17	P,T	1
	82/19	538/488	B	22	28	22	B	1
	82/20	646/492	D	24	30	10	NA	1
	82/21	554/494	Pm	24	36	16	T	1
	82/22	514/492	C	24	58	32	B	3
	82/23	Entryway A	Pm	NA	NA	NA	NA	NA
	82/24	676/508	Pm	19	22	16	T	1,4
	82/25	Entryway C	Pd	61	14	13	NA	1
	82/26	677/508	D	87	6	6	NA	2
	82/27	550/482	Pd	NA	15	7	NA	1,6
	82/28	679/510	S	60	22	18	T	1
	82/29	594/498	D	NA	NA	NA	NA	NA
	82/30	642/508	Pm	320	60	10	T	1
	82/31	676/505	Pm	NA	17	13	B	1,6
	82/32	677/511	Pm	25	56	30	B,Pd	2
	82/33	676/513	Pd	NA	14	9	NA	1,6
	82/34	554/488	Pd	NA	21	14	B	1,6
	82/35	556/478	Pd	NA	5	10	NA	2,6
	82/36	679/503	B	41	16	8	B	1
	82/37	550/484	Pd	NA	5	4	NA	2,6
	82/38	Entryway B	Pm	NA	30	23	B,Pd	1,6
	82/39	Entryway B	Pm	NA	NA	NA	P,T	1
	82/40	Entryway B	D	NA	13	26	B	1,6
	82/41	Entryway B	D	NA	16	23	B	1,6
	82/42	Entryway B	D	NA	24	14	B	1
	82/43	Entryway B	Pm	NA	16	8	B	1,6
	82/44	Entryway B	S	NA	22	17	B,Pd	2,6
	82/45	Entryway A	Pm	164	195	19	P,T	1
	82/46	Entryway A	Pm	150	200	14	P,T	2,
	82/47	574/492	Pd	NA	17	5	B	1,6
	82/48	679/508	Pd	NA	17	14	B	1,6
	82/49	680/505	Pd	61	17	7	NA	1
	82/50	676/512	D	NA	20	19	B	1,6
	82/51	679/510	Pm	158	186	16	P,T	1
	82/52	526/496	In	73	26	15	B	1
	82/53	678/509	Pd	80	29	17	B	2
	82/54	590/498	D	NA	NA	NA	NA	NA
	82/55	650/488	S	155	26	21	B	1

Site	Artifact No.	Provenience	Stage of Manufacture*	Length	Width	Thickness	Anatomical Part**	Taphonomic Process***
PgPw-3	1	342/114	D	59	13	7	NA	3
	2	340/114	D	27	12	7	NA	1
	3	328/90	Pm	107	NA	12	T	2
	5	322/90	D	75	17	14	B	1
	6	322/90	D	44	21	13	B	2
	7	322/90	Pm	91	40	27	B,T	3
	10	322/94	Pm	80	11	8	T	2
	11	322/94	B	50	17	12	T	2
	14	322/96	D	31	10	4	B	2
	15	320/96	Pm	72	23	10	T	1
	17	264/100	Pm	201	NA	15	T	2
	21	264/100	Pd	NA	18	10	B	2,6
	22	264/100	S	100	24	16	B	2
	28	270/102	Pm	113	33	12	T	1
	29	278/102	D	97	59	20	B	2
	45	324/120	S	51	24	13	T	2
	46	324/120	Pm	55	27	6	T	3
	47	324/118	Pm	140	11	8	T	3,4
	51	322/110	Pd	NA	17	13	B	2,6
	53	338/90	Pm	70	14	10	T	1
	56	322/94	Pm	222	NA	22	B,Pd	3
	57	330/94	Pd	NA	13	7	NA	1,6
	58	326/96	B	156	32	19	B	3
	60	314/102	Pm	153	NA	17	T	2
	62	310/102	Pm	151	30	15	T	1
	63	308/100	S	185	NA	22	B,Pd	3
	64	280/120	Pm	212	NA	21	P,T	2,4
	65	274/94	In	98	NA	9	T	3,4
	68	280/94	Pm	186	NA	19	T	2
	69	280/96	S	100	30	26	B	2
	70	278/96	Pm	142	NA	13	T	1
	72	278/96	Pm	167	60	20	T	2
	74	278/94	Pd	79	15	17	B	2
	75	280/102	B	132	22	10	T	2
	79	280/104	Pm	105	27	10	T	1,4
	81	262/126	Pm	300	NA	22	T	2
	82	258/124	D	295	NA	27	T	2
	83	260/124	Pf	195	NA	20	B	3
	85	264/114	Pd	39	44	10	NA	1
	90	332/116	B	60	17	13	T	3

Site	Artifact No.	Provenience	Stage of Manufacture*	Length	Width	Thickness	Anatomical Part**	Taphonomic Process***
PgPw-3	93	282/84	Pm	82	45	28	T	2
	95	290/96	In	49	21	15	B	2
	96	SC	Pm	236	50	20	B	3,4
	98	SC	D	111	30	18	B	2
	99	262/112	D	72	11	10	NA	2
	100	270/116	Pf	194	23	19	T	1
	101	TR24	B	70	33	7	B	2
	102	154/120	Pd	NA	9	7	NA	1,6
	103	254/120	Pf	76	19	6	NA	2
PhPo-3	2	140/40	Pf	44	13	10	B	1
	8	144/52	Pd	195	NA	15	B,Pd	2
	9	146/52	Pd	175	NA	16	T	2
	12	158/46	D	142	NA	13	B	2
	16	164/36	D	202	31	17	B	3
	17	166/34	PP	211	NA	20	B	2
	18	162/40	B	45	46	12	T	1
	20	162/40	B	115	26	8	B	1
	21	160/46	Pd	90	11	10	T	1
	23	162/48	B	189	39	19	B	1
	28	160/30	Pm	170	97	10	B	1
	29	152/46	S	244	38	13	B	2
	30	158/58	S	146	26	17	B	3
	31	150/68	D	62	18	7	NA	2
	32	150/64	D	132	38	14	B	1
	33	150/62	Pm	173	106	14	B	2,4
	33a	150/62	D	26	20	8	NA	[illegible]
	35	152/62	D	45	12	6	NA	2
	36	140/60	D	98	NA	15	T	2
	37	142/54	D	88	17	7	B	2
	39	150/54	D	248	139	16	T	1
	40	146/54	In	143	14	10	T	2,4
	41	160/60	In	111	NA	20	B	1
	42	136/50	C	228	55	20	NA	2,4
	45	130/66	In	362	30	22	B	3
	46	126/52	D	183	73	24	T	2
	47	126/54	D	NA	31	9	T	2,6
	47a	126/54	D	105	22	5	B	2
	48	126/62	S	245	384	27	B	1,4
	51	126/60	B	320	53	8	B	2

Site	Artifact No.	Provenience	Stage of Manufacture*	Length	Width	Thickness	Anatomical Part**	Taphonomic Process***
PhPo-3	53	126/62	Pm	149	NA	14.6	T	3
	54	126/62	Pm	NA	23	7	B	2,6
	56	124/58	D	268	14	4	T	1
	57	126/52	Pm	97	18	12	T	2
	60	136/48	D	152	NA	12	P	1
	63	134/36	D	125	NA	16	T	1
	64	132/36	Pm	899	48	20	B	2,4
	67	166/30	Pm	104	NA	10	T	1
	68	166/30	D	198	73	24	T	2
	69	166/30	D	240	187	25	T	1
	77	TR 16	S	138	12	10	T	1
	80	SC	Pd	62	23	6	NA	1
	79	SC	Pf	55	8	6	NA	1
	73	TR 11	Pd	NA	11	8	NA	1,6
	71	TR 11	Pd	37	8	4	NA	1
	72	TR 11	Pd	88	10	5	NA	1
	69	TR 10	Pd	94	10	5	NA	1
	70	TR 10	Pf	65	10	5	T	1
	74	TR 7	D	40	108	13	T	1
	75	TR 5	Pd	NA	30	7	B	2,6
	78	152/64	Pd	NA	16	16	NA	2,6
	34	152/64	Pd	60	8	8	T	2
	4	140/48	Pd	88	31	6	B	1
	11	156/36	Pd	74	27	14	NA	2
	18	162/40	Pd	NA	40	5	B	1,6
	22	162/48	Pd	90	18	11	T	1
	24	162/48	Pf	31	54	19	B	2
	27	160/32	Pf	61	16	7	NA	2
	38	142/50	Pd	NA	23	10	B	3,6
	43	136/56	Pd	135	89	26	T	2
	49	124/58	Pd	108	26	16	B	3
	65	136/44	Pd	NA	31	7	B	1,6
	66	160/52	C	158	88	15	T	2,4
	76	Row 1	D	214	59	13	P	1
	100	166/58	Pd	95	28	17	B	2
	102a	132/54	Pd	105	24	19		

Appendix II

Artifacts From Miscellaneous Sites.

Site	Artifact No.	Provenience	Stage of Manufacture*	Length	Width	Thickness	Anatomical Part**	Taphonomic Process***
PgPw-3b	330	SC	Pm	165	55	7	T	2
	331	SC	Pm	140	21	17	B,Pd	3,6
	332	SC	D	44	22	11	B	2,4
	333	SC	D	57	33	17	B	2
	334	SC	D	102	85	14	T	2
	335	SC	Pm	111	21	16	B	3,6
	336	SC	In	130	40	38	B,Pd	2
	337	SC	S	88	28	11	T	2
	338	SC	Pm	59	11	8	T	3,4
	339	SC	Pm	36	23	18	B	1
	340	SC	In	55	20	6	B	2
	341	SC	Pm	156	14	13	T	1
	342	SC	Pm	79	13	8	T	2,4
	343	SC	Pm	192	61	15	B	2,4
	344	SC	Pm	160	83	13	T	2,5
	345	SC	Pm	61	26	26	B,Pd	2,6
	346	SC	Pm	180	42	18	B	1,4
	347	SC	Pm	140	59	15	B	2,4
	348	SC	Pm	140	NA	13	T	2,4
BPW-33	349	SC	Pd	235	18	19	B	3,6
	350	SC	Pd	67	15	13	NA	1
	351	SC	Pd	82	24	13	T	3
	352	SC	Pd	28	34	6	NA	3,6
	353	SC	Pd	100	26	14	B	3,6
	354	SC	Pd	176	21	11	B	2,6
	355	SC	Pd	50	10	5	NA	3,6
	356	SC	Pd	81	10	10	T	1,6
	357	SC	Pd	58	18	10	NA	3,6
Abol 1	1	SC	C	NA	180	19	P	2
	2	SC	Pm	165	227	13	B,T	3
	3	SC	S	189	37	16	NA	1,6
JB 1	1	SC	Pm	450	180	25	B,T	2
	2	SC	Pm	350	32	26	B,T	1
	3	SC	Pm	430	28	20	B,T	2
	4	SC	Pm	136	202	18	P,T	1
	5	SC	Pm	250	26	24	P,T	2
	6	SC	B	220	27	96	B	2
	7	SC	Pd	NA	21	19	B	36
	8	SC	Pm	NA	35	23	B	3,6

Site	Artifact No.	Provenience	Stage of Manufacture*	Length	Width	Thickness	Anatomical Part**	Taphonomic Process***
PfPu-6	8	SC	Pm	NA	26	9	T	3,6
PfPu-6	9	SC	Pm	102	18	17	B,Pd	2,4
	10	SC	Pm	NA	NA	NA	B,Pd	3,4,6
PhPw-2	1	SC	Pd	NA	10	9	NA	1,6
	2	SC	D	144	20	8	NA	3
PlPx-1	16	SC	Pd	120	42	18	B	3,6
	1	SC	Pm	132	40	12	T	2
	2	SC	S	NA	30	13	T	2,6
	3	SC	Pf	146	22	16	B	2
	4	SC	Pm	NA	14	6	NA	3,6
	5	SC	Pd	106	43	20	B,Pd	3
	6	SC	Pd	95	28	9	B	2
	7	SC	Pd	NA	63	13	NA	2,6
PjRa-3	64	SC	Pd	NA	20	5	NA	1
	122	SC	Pm	54	15	7	T	1
	123	SC	Pm	NA	24	13	B	1,4,6
	12	SC	C	195	35	17	B	1
	8	SC	D	41	36	21	B	1
	118	SC	Pm	NA	NA	NA	T	1,6
	113	SC	Pd	NA	25	19	B	2,6
	125	SC	Pd	NA	16	7	T	1,6
	121	SC	Pd	NA	13	7	T	1,6
	124	SC	Pd	NA	9	7	NA	1,6
	38	SC	S	NA	40	11	P,T	3,6
	46	SC	D	32	23	16	T	1
	66	SC	S	NA	26	15	B	1,6
	108	SC	Pm	NA	20	13	B	1,4,6
	19	SC	Pm	206	47	18	P,T	1
	22	SC	Pm	NA	17	17	B	2,6
	27	SC	Pm	NA	50	15	B,T	2,6
	42	SC	Pm	NA	28	10	B,Pd	1,6
	59	SC	Pm	109	30	12	B,T	1
	7	SC	Pm	300	49	19	B,T	1
	76	SC	S	NA	26	23	B	2,6
	106	SC	D	NA	5	13	NA	3,6
	72	SC	C	162	233	15	P	1
	63	SC	Pm	190	44	25	B,T	1
	60	SC	Pm	235	33	16	B,T	1
	77	SC	Pm	183	255	17	B,T	2
	109	SC	Pm	175	30	18	B,T	1

Site	Artifact No.	Provenience	Stage of Manufacture*	Length	Width	Thickness	Anatomical Part**	Taphonomic Process***
	110	SC	D	NA	NA	NA	NA	3,6
	111	SC	In	NA	22	19	B	1,6
	112	SC	Pm	95	32	19	P	1
PjRa-4	12	SC	Pm	NA	12	5	B	2
	2	SC	D	NA	NA	NA	B,Pd	2,4
	6	SC	Pm	50	26	17	B,Pd	1
	4	SC	Pd	24	73	14	P,B	2,4
	9	SC	In	24	53	13	B	1
	8	SC	Pm	12	17	11	T	2
	1	SC	Pm	98	41	11	T	2
	10a	SC	In	107	49	6	NA	3
	3	SC	Pm	250	28	17	B,T	2,4
	7	SC	B	36	33	16	P	1
PjRa-5	8	SC	Pm	NA	38	15	B	1,6
PjRa-5a	96	SC	S	130	36	21	B	2
	37	SC	S	60	11	8A	NA	2
	99	SC	Pm	114	48	15	P,T	2
	98	SC	Pm	197	30	15	T	1
	97	SC	Pm	125	35	19	P,T	1
	101	SC	Pm	148	21	18	T	2
	61	SC	Pd	NA	13	6	B	3,6
	62	SC	Pm	52	21	11	T	3
	58	SC	Pm	100	25	12	T	2
	15	SC	D	27	22	11	P	2
PjRa-5c	12	SC	In	NA	38	6	B	1
PjRa-5d	1	SC	D	23	33	26	B	1
	3	SC	Pm	181	37	20	P,T	2
	10	SC	In	72	23	3	B	3
	8	SC	Pm	98	28	11	T	1,4
	2	SC	Pm	78	16	12	P,T	1
PjRa-7	2	SC	Pd	129	17	7	NA	1
PlRa-7	1	SC	Pd	NA	15	9	B	3,6
	3	SC	In	NA	32	18	B	3,6
	8	SC	Pd	90	19	12	NA	1
PlPx-1	19	SC	D	33	9	6	B	1
	1	SC	Pd	121	36	32	B	1
	2	SC	Pm	261	41	20	B,T	2
	3	SC	Pm	223	36	16	T	1
	4	SC	D	NA	NA	NA	B	1,6
	5	SC	Pm	65	48	8	T	1

Site	Artifact No.	Provenience	Stage of Manufacture*	Length	Width	Thickness	Anatomical Part**	Taphonomic Process***
PlPx-1	6	SC	B	5	3	9	B	1
	8	SC	D	NA	36	15	B	1
	9	SC	Pm	66	36	15	P	2
	10	SC	Pd	91	21	14	T	2
	11	SC	In	34	13	9	B	1
	12	SC	B	233	NA	NA	B,T	2
	15	SC	B	157	24	25	B	1
	16	SC	D	167	20	11	B	2
	13	SC	D	NA	23	11	B	1,6
	18	SC	D	NA	27	19	B	1,6
	17	SC	Pd	68	8	4	NA	1
PlPx-12	24	SC	Pd	NA	42	22	B	2,6
	18	SC	S	83	38	27	B	2
	11	SC	C	NA	30	22	B	2,6
	13	SC	Pd	NA	20	10	B	1,6
	21	SC	In	NA	13	9	B	2,6
	12	SC	Pd	NA	39	17	B	1,6
	15	SC	Pm	182	58	18	P,T	2
	16	SC	Pm	178	30	13	P,TO	1
	14	SC	Pf	NA	49	8	B	1,6
	27	SC	D	NA	24	5	B	2,6
	23	SC	Pd	NA	18	7	B	1,6
	22	SC	Pd	NA	9	5	T	1,6
	20,25	SC	D	NA	NA	NA	NA	1,6
	19	SC	C	202	29	16	B	1
QaPx-1	1	SC	B	220	40	12	B	2
	2	SC	In	NA	NA	NA	B,T	2
	3	SC	Pm	201	36	21	T	1
	4	SC	Pd	NA	18	13	B	1,6
	5	SC	Pm	97	25	10	B,T	2
PhPw-10	1	SC	Pm	105	80	12	T	2,4
	2	SC	In	NA	31	18	B	3,6
PjRa-12	1	SC	In	34	52	18	NA	1
	2	SC	Pd	NA	28	18	B	2,6
	3	SC	Pd	NA	18	6	B	3,6
PkPx-1	1	SC	Pm	NA	NA	NA	B,P,T	1,4
PlPw-6	1	SC	Pd	70	NA	3	B	3,6
	2	SC	Pm	139	85	7	B,T	3
PjRa-8	1	SC	Pm	NA	NA	NA	B,T	2

Site	Artifact No.	Provenience	Stage of Manufacture*	Length	Width	Thickness	Anatomical Part**	Taphonomic Process***
PiPw-8	3	SC	Pd	116	16	7	NA	3
PfPu-5	1	SC	In	NA	21	10	B	2,6
	3	SC	Pm	126	25	8	B,T	3
	4	SC	Pm	117	18	14	B	2
	5	SC	Pd	90	23	20	B	1,6

Site numbers given for miscellaneous sites are temporary field designations.